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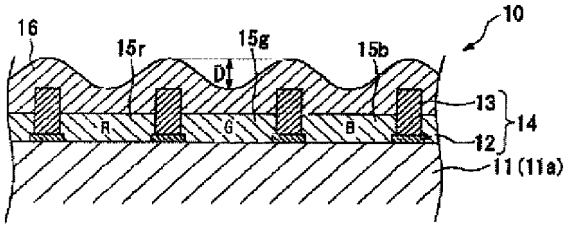
(54)【発明の名称】　カラーフィルタおよびその製造方法ならびに液晶装置および電子機器

(57)【要約】
【課題】　カラーフィルタの保護膜表面の平坦性を向上させる。保護膜表面の平坦性に優れたカラーフィルタを低コストで製造できる方法を提供する。
【解決手段】　基板11a上に着色層15r,15g,15bが形成されており 着色層15r,15g,15b上に保護膜16が形成されてなるカラーフィルタ10を製造する方法であって 複数個の基板11aを切り出すための基板母材11上に着色層15r,15g,15bを形成する着色層形成工程と 基板母材11の着色層15r,15g,15bが形成されている面の全面上にインクジェット法により保護膜用塗布液を塗布する塗布工程と 基板母材11上に塗布された保護膜用塗布液15r,15g,15bを硬化させて保護膜16を形成する硬化工程と 保護膜16が形成された基板母材11を 個々のカラーフィルタ10毎に切断する切断工程を有することを特徴とする。



【特許請求の範囲】

【請求項１】　基板上に着色層が形成されており、該着色層上に保護膜が形成されてなるカラーフィルタの製造方法であって、

基板母材上に着色層を形成する着色層形成工程と、

前記基板母材の前記着色層が形成されている面の全面上にインクジェット法により保護膜用塗布液を塗布する塗布工程と、

前記基板母材上に塗布された保護膜用塗布液を硬化させて保護膜を形成する硬化工程と、

前記保護膜が形成された前記基板母材を、個々のカラーフィルタ毎に切断する切断工程を有することを特徴とするカラーフィルタの製造方法。

【請求項２】　前記塗布工程において、インクジェットヘッドに設けられている複数のノズルから前記保護膜用塗布液を吐出しつつ、前記インクジェットヘッドと前記基板母材との位置を相対的に移動させてスキャンするとともに、１回のスキャンで形成される塗膜の幅方向の端縁がカラーフィルタの有効領域外に位置するように、前記塗膜の幅を制御することを特徴とする請求項１記載のカラーフィルタの製造方法。

【請求項３】　前記塗布工程において、前記インクジェットヘッドに設けられている複数のノズルのうち同時に保護膜用塗布液が吐出されるノズルの組み合わせを変えることにより、前記保護膜用塗布液が塗布される幅を制御することを特徴とする請求項２記載のカラーフィルタの製造方法。

【請求項４】　前記塗布工程において、塗布領域によって保護膜用塗布液の塗布量を変化させることを特徴とする請求項１ないし３のいずれかに記載のカラーフィルタの製造方法。

【請求項５】　前記着色層形成工程が、インクジェット法により着色層用塗布液を塗布する工程と、該着色層用塗布液を硬化させる工程を有しており、該着色層形成工程と前記保護膜用塗布液を塗布する塗布工程を１つの製造ライン内で行うことを特徴とする請求項１ないし４のいずれかに記載のカラーフィルタの製造方法。

【請求項６】　基板上に着色層が形成され、該着色層上に保護膜が形成されてなるカラーフィルタであって、前記保護膜がインクジェット法により形成されたものであり、該保護膜の表面段差が１μｍ以下であることを特徴とするカラーフィルタ。

【請求項７】　前記保護膜が、基板を切り出すための基板母材上に着色層を形成した後、該基板母材の前記着色層が形成されている面の全面上にインクジェット法により保護膜用塗布液を塗布し、該保護膜用塗布液を硬化させた後、前記基板母材を、個々のカラーフィルタ毎に切断することによって形成されたものであり、前記保護膜が、カラーフィルタの基板の全面上に形成されていることを特徴とする請求項６記載のカラーフィルタ。

【請求項８】　前記保護膜用塗布液の塗布が、インクジェットヘッドに設けられている複数のノズルから保護膜用塗布液を吐出しつつ、前記インクジェットヘッドと前記基板母材との位置を相対的に移動させてスキャンすることによって行われ、１回のスキャンで塗布された塗膜の幅方向の端縁がカラーフィルタの有効領域外に存在していることを特徴とする請求項７記載のカラーフィルタ。

【請求項９】　請求項６ないし８のいずれかに記載のカラーフィルタと、該カラーフィルタの保護膜が形成されている側に対向配置された対向基板と、前記カラーフィルタと前記対向基板との間に挟持された液晶組成物とを備えてなることを特徴とする液晶装置。

【請求項１０】　請求項９記載の液晶装置を具備してなることを特徴とする電子機器。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、カラーフィルタおよびその製造方法ならびに液晶装置および電子機器に関するものである。

【０００２】

【従来の技術】近年、ノートパソコン、携帯電話機、電子手帳等の電子機器において、情報を表示する手段として液晶装置が広く使用されている。最近では、液晶層を挟んで対向する一対の基板のうち、一方の基板にカラーフィルタを配置してフルカラー表示を可能としたカラー液晶装置が主流になっている。カラーフィルタは、例えば図１４に示すように、ガラスやプラスチック等により形成された透明基板５０１の表面上に、Ｒ（赤）、Ｇ（緑）、Ｂ（青）の着色層５０２ｒ，５０２ｇ，５０２ｂが形成され、その上に必要に応じて保護膜５０３が形成されている。３色の着色層５０２ｒ，５０２ｇ，５０２ｂはそれぞれ画素を構成するもので、これらはストライプ配列、デルタ配列、またはモザイク配列などの配列で並べられている。また、画素間には遮光層からなるブラックマトリクス５０４が設けられている。さらに、保護膜５０３上にＩＴＯ膜などからなる透明電極層５０５が設けられる。保護膜５０３は、着色層５０２ｒ，５０２ｇ，５０２ｂが形成された状態での表面段差を埋めて平坦にする、透明電極層５０５を形成するプロセスにおいて着色層５０２ｒ，５０２ｇ，５０２ｂの熱劣化を防ぐなどの目的で形成される。

【０００３】このような構成のカラーフィルタを製造するには、例えば透明基板５０１上に、フォトリソグラフ法を用いて、まずブラックマトリクス５０４、次いでＲ（赤）、Ｇ（緑）、Ｂ（青）の着色層５０２ｒ，５０２ｇ，５０２ｂを形成した後、この３色の着色層５０２ｒ，５０２ｇ，５０２ｂの上層に保護膜５０３を形成する。

【０００４】保護膜５０３の形成方法としては、塗布液

をスピンコート法で塗布した後、加熱硬化せしめて保護膜５０３を形成する方法があるが、この方法は、保護膜５０３の表面を平坦にする点では優れているものの、供給された塗布液が飛散してしまうため、塗布液の無駄が多く、生産コストが高くなる不都合があった。また、塗布時に基板を回転させるため、遠心力により塗布液が内側から外側へと流動して外周領域の膜厚が厚くなる傾向があり、その結果、保護膜５０３の膜厚のばらつきが大きくなるという不都合があった。これらの対策のため、近年、いわゆるインクジェットを利用した技術が提案されている。

【０００５】例えば、特開平９－３２９７０７号公報には、インクジェット法によりパターニングされた保護膜５０３を形成する方法が記載されている。この方法は、インクジェット法により、図１４に示すように、カラーフィルタの有効領域上にのみ保護膜形成用の塗布液を塗布し、予備乾燥した後、加熱処理して硬化させる方法である。

【０００６】

【発明が解決しようとする課題】しかしながら、この方法では予備乾燥を行ったときに、図１５に例示するようにカラーフィルタの有効領域上に塗布された塗膜５１３のエッジ部５１３ａが他の部分より厚くなって盛り上がるため、硬化後の保護膜５０３の表面が平坦にならないという問題があった。このようにカラーフィルタの保護膜５０３の表面に段差が生じていると、このカラーフィルタを用いて液晶装置を構成したときに、カラーフィルタの保護膜５０３側に設けられる液晶層にギャップムラが生じ、それによって表示画面における輝度ムラが生じてしまうという問題があった。

【０００７】したがって本発明の課題は、保護膜表面の平坦性に優れたカラーフィルタを提供すること、および保護膜表面の平坦性に優れたカラーフィルタを低コストで製造できる方法を提供することにある。また、本発明のカラーフィルタを用いた液晶装置および電子機器を提供することを課題とする。

【０００８】

【課題を解決するための手段】本発明は前記課題の少なくとも１つを解決するものであり、本発明のカラーフィルタの製造方法は、基板上に着色層が形成されており、該着色層上に保護膜が形成されてなるカラーフィルタの製造方法であって、基板母材上に着色層を形成する着色層形成工程と、前記基板母材の前記着色層が形成されている面の全面上にインクジェット法により保護膜用塗布液を塗布する塗布工程と、前記基板母材上に塗布された保護膜用塗布液を硬化させて保護膜を形成する硬化工程と、前記保護膜が形成された前記基板母材を、個々のカラーフィルタ毎に切断する切断工程を有することを特徴とする。

【０００９】このカラーフィルタの製造方法によれば、保護膜用塗布液は、基板母材の全面上に塗布されるので、塗膜のエッジ部は基板母材の外周部となる。したがって、保護膜用塗布液を硬化させる工程で塗膜のエッジ部に盛り上がりが生じても、基板母材の外周部がその内方の部分より厚くなるに過ぎない。よって、基板母材上において、塗膜が厚くなる基板母材の外周部に個々のカラーフィルタの有効領域が含まれないように設計すれば、少なくともカラーフィルタの有効領域内においては保護膜の表面を平坦に形成することができる。

【００１０】また本発明のカラーフィルタの製造方法は、前記塗布工程において、インクジェットヘッドに設けられている複数のノズルから前記保護膜用塗布液を吐出しつつ、前記インクジェットヘッドと前記基板母材との位置を相対的に移動させてスキャンするとともに、１回のスキャンで形成される塗膜の幅方向の端縁がカラーフィルタの有効領域外に位置するように、前記塗膜の幅を制御することを特徴とする。

【００１１】通常のインクジェットを用いた塗布方式においては、塗布液を吐出するノズルを複数備えたインクジェットヘッドから同時に吐出される塗布液によって塗布される領域は、最終的に塗膜を形成しようとしている全体の塗布領域より小さい。したがって、インクジェットヘッドを移動（スキャン）させながら、全体の塗布領域を塗布するので、スキャンとスキャンの境界（改行部）において塗膜が不均一になり易い。本発明の方法によれば、インクジェットヘッドに設けられている複数のノズルから保護膜用塗布液を吐出しつつ、インクジェットヘッドと基板母材との位置を相対的に移動させてスキャンするとともに、１回のスキャンで形成される塗膜の幅方向の端縁がカラーフィルタの有効領域外に位置するように、前記塗膜の幅を制御するので、スキャンとスキャンの境界（改行部）はカラーフィルタの有効領域外に形成され、有効領域内には均一な塗膜が形成される。ここで、塗膜の幅方向とは、スキャン時にインクジェットヘッドが相対的に進行する方向に対して垂直な方向である。

【００１２】本発明において、保護膜用塗布液が塗布される幅の制御は、前記塗布工程において、前記インクジェットヘッドに設けられている複数のノズルのうち同時に保護膜用塗布液が吐出されるノズルの組み合わせを変えることにより行うのが好ましい。かかる方法によれば、インクジェット法により保護膜用塗布液を塗布する際の塗膜の幅を容易に、かつ高精度に制御することができ、基板母材等の設計変更にも容易に対応することができる。

【００１３】また本発明は、前記塗布工程において、塗布領域によって保護膜用塗布液の塗布量を変化させることもできる。本発明では、保護膜の形成にインクジェットを用いるので、保護膜を形成しようとしている面の凹凸に応じて塗布量を変化させることが可能であり、これ

によって保護膜表面の平坦性をより向上させることができる。

【００１４】また本発明のカラーフィルタの製造方法は、前記着色層形成工程が、インクジェット法により着色層用塗布液を塗布する工程と、該着色層用塗布液を硬化させる工程を有しており、該着色層形成工程と前記保護膜用塗布液を塗布する塗布工程を１つの製造ライン内で行う構成とすることができる。かかる方法は、着色層の形成にもインクジェットを用い、これに連続して、インクジェットを用いた保護膜の形成を１つの製造ライン内で行うので、作業効率を高め、生産性を向上させることができ、量産化を実現する上で好ましい。

【００１５】本発明のカラーフィルタは、基板上に着色層が形成され、該着色層上に保護膜が形成されてなるカラーフィルタであって、前記保護膜がインクジェット法により形成されたものであり、該保護膜の表面段差が１μｍ以下であることを特徴とする。

【００１６】本発明において、カラーフィルタの保護膜をインクジェット法により形成することによって、その表面段差を１μｍ以下に抑えることができる。カラーフィルタの保護膜の表面段差が１μｍ以下であれば、保護膜表面の平坦性が良好であり、このカラーフィルタを用いて液晶装置を構成したときに、カラーフィルタの保護膜側に設けられる液晶層のギャップの均一性が良好となる。これにより液晶層のギャップムラに起因する輝度ムラ等の表示不良が抑えられ、良好な表示が得られる。

【００１７】本発明のカラーフィルタは、前記保護膜が、基板を切り出すための基板母材上に着色層を形成した後、該基板母材の前記着色層が形成されている面の全面上にインクジェット法により保護膜用塗布液を塗布し、該保護膜用塗布液を硬化させた後、前記基板母材を、個々のカラーフィルタ毎に切断することによって形成されたものが好ましく、かかる方法を用いた製造されたカラーフィルタは、前記保護膜が、カラーフィルタの基板の全面上に形成されているという特徴を有する。

【００１８】本発明のカラーフィルタは、基板母材の全面上に保護膜を形成した後に、個々のカラーフィルタ毎に切断して得られたものであるので、基板母材を切断する際に、保護膜形成時に塗膜のエッジ部で生じた盛り上がりを切り落とすことができる。したがって、個々のカラーフィルタの基板上の保護膜は、表面の平坦性に優れたものとなる。

【００１９】本発明のカラーフィルタは、前記保護膜用塗布液の塗布が、インクジェットヘッドに設けられている複数のノズルから保護膜用塗布液を吐出しつつ、前記インクジェットヘッドと前記基板母材との位置を相対的に移動させてスキャンすることによって行われたものが好ましく、かかる方法を用いれば、１回のスキャンで塗布された塗膜の幅方向の端縁がカラーフィルタの有効領域外に存在するカラーフィルタが得られる。かかる構成のカラーフィルタにあっては、カラーフィルタの有効領域内に、インクジェットの改行による塗膜の不均一部分が形成されないので、表面の平坦性に優れた均質な保護膜を備えたものとなる。

【００２０】本発明の液晶装置は、本発明のカラーフィルタと、該カラーフィルタの保護膜が形成されている側に対向配置された対向基板と、前記カラーフィルタと前記対向基板との間に挟持された液晶組成物とを備えてなることを特徴とする。また本発明の電子機器は、本発明の液晶装置を具備してなることを特徴とする。

【００２１】本発明の液晶装置によれば、保護膜の表面平坦性に優れたカラーフィルタを用い、保護膜の上層に液晶組成物からなる層が設けられるので、液晶層のギャップの均一性に優れている。したがって、ギャップムラに起因する輝度ムラ等の表示不良が抑えられ、良好な表示が得られる。また本発明の電子機器によれば、保護膜の表面平坦性に優れたカラーフィルタを備え、液晶層のギャップの均一性に優れた液晶装置が用いられているので、輝度ムラ等の表示不良が防止されて、良好な液晶表示が得られる。

【００２２】

【発明の実施の形態】以下、本発明に係る第１実施形態を、図１から図７を参照しながら説明する。図１は本実施形態のカラーフィルタを示す部分断面図である。このカラーフィルタ１０は、基板１１ａ上に、マトリクス状に配された画素を備えており、画素と画素の境目は、遮光層からなるブラックマトリクス１２と、その上に形成されたバンク１３とからなる仕切り１４によって区切られている。１つ１つの画素にはＲ（赤）、Ｇ（緑）、Ｂ（青）のいずれかのインクからなる着色層１５ｒ、１５ｇ、１５ｂが形成されており、これらの全体を覆うように保護膜１６が形成されている。Ｒ、Ｇ、Ｂの配列は、いわゆるモザイク配列でもよく、ストライプ配列、デルタ配列など、その他の配列でも構わない。

【００２３】図２は、本実施形態のカラーフィルタ１０を製造するのに好適に用いられる製造ラインの例を示す概略構成図である。この例の製造ラインは、インクジェット法により着色層１５ｒ、１５ｇ、１５ｂを形成する工程を実行するための着色層形成装置５１と、インクジェット法により保護膜１６を形成する工程を実行するための保護膜形成装置５２とを備えており、これらの装置の間には搬送手段が設けられている。着色層形成装置５１は、第１～第３のインクジェット装置３１、３２、３３と、各インクジェット装置３１、３２、３３の後段に設けられた第１～第３の乾燥装置４１、４２、４３とを備えており、第３の乾燥装置４３の後段にはインクをポストベークするためのオーブン４６が設けられている。また各装置間には搬送手段が設けられている。保護膜形成装置５２は、第４のインクジェット装置３４と、第４の乾燥装置４４と、硬化装置４５が順に設けられてお

り、各装置間には搬送手段が設けられている。

【００２４】カラーフィルタ１０の着色層１５ｒ、１５ｇ、１５ｂをインクジェット法により形成する方法は公知であり（例えば、特開平４－１２３００７号公報）、着色層形成装置５１は、既知のインクジェット装置および乾燥装置を適宜用いて構成することができる。

【００２５】図３ないし図６は、第４のインクジェット装置３４の例を示したものであり、図３はインクジェット装置３４の概略構成図、図４はインクジェットヘッド７２の配列を示す平面図、図５および図６はインクジェット７２の説明図である。この第４のインクジェット装置３４は、基板母材１１上に対して保護膜用塗布液Ｌを吐出するインクジェットヘッド７２を複数備えたインクジェットヘッド群１と、インクジェット機構２と、インクジェットヘッド群１と基板母材１１との位置を相対的に移動可能な移動機構３と、インクジェット機構２および移動機構３を制御する制御部Ｃとを備えている。

【００２６】上記移動機構３は、基板ステージ４上に載置された基板母材１１の上方に、インクジェットヘッド群１をインクジェットヘッド７２のノズル６７が下方を向くように支持すると共に基板母材１１に対して任意の位置に移動させるヘッド支持部５と、上方のインクジェットヘッド群１に対して基板ステージ４と共に基板母材１１を移動させるステージ駆動部６とから構成されている。

【００２７】上記ヘッド支持部５は、インクジェットヘッド群１を水平方向（Ｘ軸）および垂直方向（Ｚ軸）に任意の移動速度で移動可能なかつ位置決め可能なリニアモータ等の機構と、垂直中心軸を中心にインクジェットヘッド群１を回転させて下方の基板母材１１に対して任意な角度に設定可能なステッピングモータ等の機構とを備えている。

【００２８】上記ステージ駆動部６は、垂直中心軸を中心に基板ステージ４を回転させて上方のインクジェットヘッド群１に対して任意な角度に設定可能なθ軸ステージ７と、基板ステージ４をインクジェットヘッド群１の水平移動方向に直交する水平方向（Ｙ軸）に移動可能なかつ位置決め可能なＹ軸ステージ８とを備えている。なお、θ軸ステージ７は、ステッピングモータ等から構成され、Ｙ軸ステージ８は、リニアモータ等から構成されている。

【００２９】上記インクジェット機構２は、インクジェットヘッド群１にチューブ９ａを介して接続され該インクジェットヘッド群１のインクジェットヘッド７２に保護膜用塗布液Ｌを供給するために保護膜用塗布液Ｌを貯留するタンク９ｂを備えている。すなわち、タンク９ｂからチューブ９ａを介してインクジェットヘッド群１のインクジェットヘッド７２に保護膜用塗布液Ｌを充填することにより、塗布が行われる。上記インクジェットヘッド７２は、例えばピエゾ素子によって液室を圧縮してその圧力波で液体を吐出させる吐出機構を備えており、一列又は複数列に配列された複数のノズル６７を有している。

【００３０】図４は、インクジェットヘッド群１におけるノズル６７の配列の例を示したもので、インクジェットヘッド群１の下面（基板ステージ４に対向する面）を平面視した図である。この例において、インクジェットヘッド群１には、所定数のノズル６７と吐出機構７１とを備えたインクジェットヘッド７２が１２個（６個×２列）設けられている。インクジェットヘッド群１が、基板ステージ４上の基板母材１１に対して相対的に進行する方向をＳとし、この方向に垂直な方向を幅方向Ｗとすると、１２個のインクジェットヘッド７２は、ノズル６７が進行方向Ｓに対して任意の角度を有する一方向に沿って列をなすように、かつ進行方向Ｓに平行で各ノズル６７を通る直線が、幅方向Ｗにおいて等間隔となるように配置されている。１個のインクジェットヘッド７２に設けられるノズル６７の数や、インクジェットヘッド７２の数は適宜変更可能であるが、インクジェットヘッド群１に設けられている複数のノズル６７から吐出される塗液によって同時に塗布できる幅（幅方向Ｗにおける大きさ）が、１個のカラーフィルタ１０の有効領域の大きさよりも大きくなるように設定される。

【００３１】各インクジェットヘッド７２の構造は、例えば図５および図６に示すように、ステンレス製のノズルプレート６１と振動板６２とを備え、両者は仕切部材（リザーバプレート）６３を介して接合されている。ノズルプレート６１と振動板６２との間には、仕切部材６３によって複数の空間６４と液溜まり６５とが形成されている。各空間６４と液溜まり６５の内部は保護膜用塗布液Ｌで満たされており、各空間６４と液溜まり６５とは供給口６６を介して連通している。さらに、ノズルプレート６１には、空間６４から保護膜用塗布液Ｌを噴射するための孔となるノズル６７が設けられている。一方、振動板６２には液溜まり６５に保護膜用塗布液Ｌを供給するための孔６８が形成されている。

【００３２】また、振動板６２の空間６４に対向する面と反対側の面上には圧電素子（ピエゾ素子）６９が接合されている。この圧電素子６９は一対の電極７０の間に位置し、通電すると圧電素子６９が外側に突出するように撓曲し、同時に圧電素子６９が接合されている振動板６２も一体となって外側に撓曲する。これによって空間６４の容積が増大する。したがって、空間６４内に増大した容積分に相当する保護膜用塗布液Ｌが液溜まり６５から供給口６６を介して流入する。次に、圧電素子６９への通電を解除すると、圧電素子６９と振動板６２はともに元の形状に戻る。これにより、空間６４も元の容積に戻るため、空間６４内部の保護膜用塗布液Ｌの圧力が上昇し、ノズル６７から基板母材１１に向けて保護膜用塗布液Ｌの液滴６０が吐出される。なお、インクジェッ

トヘッド７２のインクジェット方式としては、上記の圧電素子を用いたピエゾジェットタイプ以外の方式でもよく、例えば、エネルギー発生素子として電気熱変換体を用いたインク発泡圧力噴出方式（例えばバブルジェット（登録商標）方式）等の方式を採用しても構わない。

【００３３】上記制御部Ｃは、装置全体の制御を行うマイクロプロセッサ等のＣＰＵや各種信号の入出力機能を有するコンピュータなどであり、インクジェット機構２および移動機構３にそれぞれ電気的に接続され、インクジェット機構２による吐出動作および移動機構３による移動動作の少なくとも一方を制御して保護膜用塗布液Ｌの塗布条件を変える機能を有している。

【００３４】本実施形態において制御部Ｃは、それぞれのインクジェットヘッド７２において、複数のノズル６７のうち同時に保護膜用塗布液Ｌが吐出されるノズル６７の組み合わせを変える機能を備えている。これにより、インクジェットヘッド７２における塗布液Ｌの吐出位置を変更することができ、インクジェットヘッド群１を進行方向Ｓに１回移動させたときに（１スキャン）、基板母材１１上に保護膜用塗布液Ｌが塗布される幅を制御することができる。また、インクジェットヘッド群１の進行方向Ｓに平行でノズル６７を通る直線の全部について、その直線上において同時に保護膜用塗布液Ｌが吐出されるノズル６７の数が等しくなるように制御すれば、塗布量を均一にする上で好ましい。

【００３５】さらに、制御部Ｃが、保護膜用塗布液Ｌが塗布される領域によって塗布量を制御できる機能を備えることが好ましい。例えば、各ノズル６７からの吐出量を個別に変える制御機能および／または基板母材１１上の同一位置に繰り返し塗布を行う際に繰り返す塗布ごとに塗布条件を設定する制御機能等を設けて、１スキャンで塗布された塗膜の中でも、膜厚が異なる部位が存在するように制御可能とすることが好ましい。かかる構成とすれば、保護膜用塗布液Ｌを塗布する直前の、基板母材１１の表面の凹凸形状に応じて塗布量を変化させ、保護膜１６の表面段差Ｄをさらに小さくすることが可能となる。

【００３６】図７（ａ）～（ｅ）は、本実施形態のカラーフィルタ１０を製造する方法を工程順に示した模式断面図である。まず、１個のカラーフィルタ１０の基板１１ａを複数個切り出すことができる大きさの基板母材１１を用意し、図７（ａ）に示すように、基板母材１１上にブラックマトリクス１２を形成する。基板母材１１としては、一般にガラス基板が用いられるが、カラーフィルタとしての用途において必要とされる透明性、機械的強度等の特性を有するものであれば、ガラス以外の材料を用いることもできる。

【００３７】ブラックマトリクス１２は、金属クロム、金属クロムと酸化クロムの積層体、または樹脂ブラック等で形成される。金属薄膜からなるブラックマトリクス１２を形成するには、スパッタ法や蒸着法を用いることができる。また樹脂薄膜からなるブラックマトリクス１２を形成するには、グラビア印刷法、フォトレジスト法、熱転写法等を用いることができる。

【００３８】続いて、ブラックマトリクス１２上にバンク１３を形成する。すなわち、図７（ｂ）に示すように、基板母材１１およびブラックマトリクス１２を覆うように、ネガ型の透明な感光性樹脂組成物からなるレジスト層１７を形成し、その上面に、マトリクスパターン形状に形成されたマスクフィルム１８を密着させた状態で露光処理を行う。そして、図７（ｃ）に示すように、レジスト層１７の未露光部分をエッチング処理することによりレジスト層１７をパターニングして、バンク１３を形成する。このバンク１３とその下のブラックマトリクス１２は、この後の工程において、インクジェット法により着色層１５ｒ、１５ｇ、１５ｂを形成する際にインクの広がりを規制する土手の役割を果たす仕切り１４となる。

【００３９】バンク１３を形成する材料として、塗膜表面が疎インク性となる樹脂材料を用いると、ガラス基板（基板母材１１）表面が親インク性であるので、この後の工程で、インクジェット法によりバンク１３で囲まれた基板母材１１上に着色層１５ｒ、１５ｇ、１５ｂを形成する際の、インクの着弾位置精度が向上するので好ましい。なおこの場合には着色層１５ｒ、１５ｇ、１５ｂ形成後、保護膜１６を形成する前にバンク１３の上面を親インク化することが好ましく、そのための装置を着色層形成装置５１と保護膜形成装置５２との間に設けることが好ましい。

【００４０】次に、図７（ｄ）に示すように、仕切り１４で囲まれた領域内、すなわち画素に着色層用塗布液（インク）を塗布し、これを乾燥させて着色層１５ｒ、１５ｇ、１５ｂを形成する。本実施形態では、第１～第３のインクジェット装置３１、３２、３３を備えた着色層形成装置５１を用いて、３色の着色層１５ｒ、１５ｇ、１５ｂを順に形成する。３色の着色層１５ｒ、１５ｇ、１５ｂの形成順序は限定されない。

【００４１】例えば、まず、仕切り１４が形成された基板母材１１を第１のインクジェット装置３１に導入し、多数の画素のうちＲ（赤）の着色層１５ｒからなる画素が形成される領域のみに対して、インクジェットヘッド（図示略）から赤色のインクを吐出する。この後、第１の乾燥装置４１に搬送し、ここでインクを乾燥させてＲ（赤）の着色層１５ｒを形成する。続いて、Ｒ（赤）の着色層１５ｒが形成された基板母材１１を第２のインクジェット装置３２に搬送し、多数の画素のうちＧ（緑）の着色層１５ｇからなる画素が形成される領域のみに対して、インクジェットヘッド（図示略）から緑色のインクを吐出する。そして、第２の乾燥装置４２に搬送し、ここでインクを乾燥させてＧ（緑）の着色層１５ｇを形

成する。続いて、R（赤）の着色層１５ｒおよびG（緑）の着色層１５ｇが形成された基板母材１１を第３のインクジェット装置３３に搬送し、多数の画素のうちB（青）の着色層１５ｂからなる画素が形成される領域のみに対して、インクジェットヘッド（図示略）から青色のインクを吐出する。この後、第３の乾燥装置４３に搬送し、ここでインクを乾燥させてB（青）の着色層１５ｂを形成する。なお、第１～第３のインクジェット装置３１、３２、３３内において、基板母材１１を精密に位置決めできるように、例えばブラックマトリクス１２を形成する際に、位置合わせ用のマークを形成しておくことが好ましい。

【００４２】着色層１５ｒ、１５ｇ、１５ｂを形成するインクは、粘度が２～２０ｍＰａ・ｓで、ノズルプレートに対する接触角が５０°より大きく、表面張力が２０～４０ｍN／ｍであるものが好ましい。インクの粘度が高すぎると、インクが吐出した後の次のインクの供給が間に合わなくて吐出不良を起こすおそれがあり、粘度が低すぎると流動性がよすぎてインクの過供給となるおそれがある。またインクのノズルプレートに対する接触角が低すぎるとノズルプレートがインクで濡れてしまい、インク滴が吐出される際に、ノズルプレートに付着したインクに、インク滴が引き寄せられて、正確な位置へ吐出されないおそれがある。またインクの表面張力が大きすぎても、小さすぎても、圧電素子の振動による安定したメニスカスコントロールができなくなる。例えばアクリル樹脂カラーペースト、水性メラミンカラーペースト等が使用できる。

【００４３】着色層１５ｒ、１５ｇ、１５ｂの厚さは、ＲＧＢの各層によって差があるが、概ね０．８～１．２μｍの範囲内とされる。インクを乾燥させる工程は３０～８０℃の温度範囲で、３～５分間の条件で行うのが好ましく、これらの条件に適合するように、第１～第３の乾燥装置４１、４２、４３の構成および搬送条件等を設定するのが好ましい。また、３色の着色層１５ｒ、１５ｇ、１５ｂを形成した後、オーブン４６でポストベーク（本焼き）を行ってインクを硬化させる。このときの加熱条件は、例えば２２０℃、３０分間程度に好ましく設定される。

【００４４】この後、図７（ｅ）に示すように、基板母材１１、仕切り１４、および着色層１５ｒ、１５ｇ、１５ｂの上面を覆うように保護膜１６を形成する。すなわち、着色層１５ｒ、１５ｇ、１５ｂが形成された基板母材１１は、保護膜形成装置５２へ搬送され、第４のインクジェット装置３４で基板母材１１の着色層１５ｒ、１５ｇ、１５ｂが形成されている面全体に保護膜用塗布液Ｌが塗布され、第４の乾燥装置４４で予備乾燥された後、硬化装置４５で該塗布液Ｌが硬化されて保護膜１６が形成される。

【００４５】保護膜用塗布液Ｌとしては、保護膜としての用途に要求される特性を満たし、インクジェットにより塗布可能なものであれば使用可能であるが、着色層１５ｒ、１５ｇ、１５ｂを形成するインクと同様に、粘度が２～２０ｍＰａで、ノズルプレートに対する接触角が３５°以上、より好ましくは５０°より大きく、表面張力が２０～４０ｍN／ｍであるものが好ましい。また材料を選定する際には、塗布後の表面が速やかに平坦になるレベリング性が良いもの、塗布面に対する濡れ性が良いものが好ましく、特に溶剤は後の乾燥工程における乾燥法と適合性が良いものが好ましい。また添加剤は保護膜の性質を劣化させないものを用いる。保護膜用塗布液Ｌの硬化速度は、溶剤の配合を変更することによって変化させることができるが、硬化速度が速すぎると、塗布された塗膜が平坦化される前に硬化してしまって、保護膜１６表面の平坦性が悪くなるおそれがある。逆に、硬化速度が遅すぎると、乾燥時間が長くかかるので生産性が悪くなる。

【００４６】この保護膜用塗布液Ｌとしては、例えば、アクリル系樹脂１０～２０重量%、エポキシ樹脂０．１～３重量%、カップリング剤０．１～３重量%、ジエチレングリコールジメチルエーテル（沸点１６２℃の溶剤）３５～６０重量%、およびブチルカルビトールアセテート（沸点２４７℃の溶剤）２０～４５重量%からなり、粘度４～８ｍＰａ・ｓ、ノズルプレートに対する接触角４６～５２°、表面張力２５～２９ｍN／ｍである熱硬化性樹脂組成物を好ましく用いることができる。

【００４７】乾燥後の保護膜１６の厚さは、薄すぎると、仕切り１４と着色層１５ｒ、１５ｇ、１５ｂとの段差を埋めて表面を平坦化する効果が十分に得られず、厚すぎると乾燥時間が長くかかり生産性が悪くなる。本実施形態において、保護膜１６を形成する直前の、仕切り１４と着色層１５ｒ、１５ｇ、１５ｂとの段差は一般的に１．５～１．８μｍ程度であり、これを埋める保護膜１６の膜厚は硬化後において３．０～４．０μｍ程度とすることが好ましい。

【００４８】第４のインクジェット装置３４で保護膜用塗布液Ｌを塗布するには、まず基板ステージ４上に基板母材１１をセットし、基板母材１１の塗布開始位置の上方にインクジェットヘッド群１が位置するように、インクジェットヘッド群１および／または基板ステージ４を移動させる。次いで、インクジェットヘッド群１のインクジェットヘッド７２から保護膜用塗布液Ｌを所定の吐出間隔で吐出させつつ、基板ステージ４をＹ方向に移動させて１スキャン目の塗布を行う。この場合、インクジェットヘッド７２の相対的な進行方向ＳはＹ方向となる。そして、インクジェットヘッド群１をＸ方向に移動させて改行を行った後、再びインクジェットヘッド７２から保護膜用塗布液Ｌを所定の吐出間隔で塗出させつつ、基板ステージ４をＹ方向に移動させて２スキャン目の塗布を行う。このようにスキャンの改行とを繰り返し

ながら、基板母材１１の全面に保護膜用塗布液Ｌを塗布する。あるいはインクジェットヘッド群１のインクジェットヘッド７２から保護膜用塗布液Ｌを塗出させつつ、インクジェットヘッド群１をＸ方向に移動させて１スキャンの塗布を行い、改行時に基板ステージ４をＹ方向に移動させてもよい。この場合、インクジェットヘッド７２の相対的な進行方向ＳはＸ方向となる。

【００４９】１スキャンで形成される塗膜の幅を１個のカラーフィルタ１０の有効領域よりも大きくし、１回のスキャンで形成される塗膜の幅方向の端縁がカラーフィルタの有効領域外に位置するように塗布を行う。また、所望の膜厚が得られるように塗布量を制御することが好ましい。単位面積当たりの塗布量は、基板母材１１の全面において均一としてもよく、あるいは、保護膜用塗布液Ｌを塗布する直前の基板母材１１の表面の凹凸に応じて、部位によって塗布量を変えてもよい。例えば、仕切り１４と着色層１５ｒ、１５ｂ、１５ｃとでは高さが異なるので、それぞれの上面に保護膜用塗布液Ｌを吐出する際の吐出量を変えるように制御すれば、保護膜１６の表面の平坦性をより向上させることができる。

【００５０】具体的には、制御部Ｃによって、各ノズル６７からの塗布液Ｌの吐出量を変えることにより膜厚の制御を行うことができる。すなわち、吐出量に比例して単位面積当たりの塗布量が変化し、吐出量を増やせば膜厚を厚くすることができると共に、吐出量を減らせば膜厚を薄くすることができる。あるいは、基板母材１１上の同一位置に繰り返し塗布を行う際に、繰り返す塗布ごとに上記各ノズル６７からの塗布液Ｌの吐出量をそれぞれ制御することによっても塗膜の膜厚を制御することができる。

【００５１】第４の乾燥装置４４で保護膜用塗布液の塗膜を予備乾燥させる工程は、スピン乾燥法、ホットプレート乾燥法、真空乾燥法など既知の手法を適宜用いることができる。乾燥前の塗膜の状態だけでなく、乾燥法の違いによっても、乾燥後の保護膜１６の表面平坦性は変化し得るので、保護膜１６表面の仕上がりや、生産性等を考慮しつつ、乾燥前の塗膜の表面状態に応じて適宜の乾燥法を採用することが好ましい。

【００５２】予備乾燥後の塗膜を硬化装置４５で硬化させる工程は、予備乾燥後の基板母材１１を温風送風機構を備えたオーブン等の加熱手段を備えた硬化装置４５にて加熱処理することによって、塗膜を硬化させて保護膜１６とする。加熱時の条件は、塗膜の材料や膜厚等に応じて適宜設定される。

【００５３】このようにして保護膜１６を形成した後、基板母材１１を個々の有効領域毎に切断することによって、カラーフィルタ１０が得られる。また、このカラーフィルタ１０を液晶装置に用いる場合には、基板母材１１を用いて液晶パネルを組み立てた後、あるいは液晶パネルを組み立てる途中で、基板母材１１を各カラーフィルタ毎に切断することが好ましい。

【００５４】本実施形態によれば、保護膜１６の表面段差Ｄを１μｍ以下に小さくすることができる。ここでの表面段差Ｄの値とは、接触式段差測定装置で表面を測定した時の上端と下端との差の値をいう。また保護膜１６の形成にインクジェット法を用いているので、スピンコート法を用いる場合に比べて塗布液の使用量が少なくて済み、表面の平坦性に優れたカラーフィルタを低コストで製造することができる。

【００５５】なお、本実施形態では、インクジェット装置において、塗布液Ｌを吐出する手段としてインクジェットヘッド７２を複数個備えたインクジェットヘッド群１を用いたが、１スキャンで所望の幅の塗膜が得られれば、吐出手段を１個のインクジェットヘッドだけで構成することも可能である。本実施形態のように、複数のインクジェットヘッド７２を用いて吐出手段を構成すれば、既存の小型のインクジェットヘッドを使用して、１スキャンで比較的幅が広い塗膜が得られるように構成することができる。

【００５６】また、インクジェットヘッド群１におけるインクジェットヘッド７２の配列は、本実施形態の配列に限らず、ノズル６７が進行方向Ｓに対して任意の角度を有する一方向に沿って列をなしており、かつ進行方向Ｓに平行で各ノズル６７を通る直線が、幅方向Ｗにおいて等間隔となるように配置されていればよく、適宜の配列とすることができる。例えば、図８に示すように、インクジェットヘッド７２を幅方向Ｗに複数個、この図の例では３個、進行方向Ｓに２列設けるとともに、各インクジェットヘッド７２はノズル６７が幅方向Ｗに沿って列をなすように配置してもよい。１列目のインクジェットヘッド７２の幅方向Ｗの端部７２ａにおいて進行方向Ｓに平行でノズル６７を通る直線と、２列目のインクジェットヘッド７２の幅方向Ｗの端部７２ｂにおいて進行方向Ｓに平行でノズル６７を通る直線は、一部重なるように構成するのが好ましい。なお、この図ではインクジェットヘッドの吐出機構は図示を省略している。

【００５７】図９は、本実施形態のカラーフィルタ１０を用いて液晶装置を構成した第１の例を示したもので、パッシブマトリックス型液晶装置（液晶装置）の概略構成を示す断面図である。この例の液晶装置１００に、液晶駆動用ＩＣ、バックライト、支持体などの付帯要素を装着することによって、最終製品としての透過型液晶表示装置が得られる。

【００５８】この液晶装置１００は、第１の実施形態で説明したカラーフィルタ１０を備えており、カラーフィルタ１０を上側（観測者側）に配置したものである。

尚、本実施形態においてはカラーフィルタ１０について簡略に説明することとする。この図には透過型液晶装置１００の要部を示しており、この液晶装置１００は、カラーフィルタ１０とガラス基板等からなる対向基板１０

１との間にＳＴＮ（Super Twisted Nematic）液晶組成物等からなる液晶層１０３が挟持されて概略構成されている。カラーフィルタ１０は、第１の実施形態で説明したカラーフィルタと同じものであり、基板１１ａ、ブラックマトリクス１２とバンク１３とからなる仕切り１４、着色層１５ｒ、１５ｇ、１５ｂ、および保護膜１６を備えている。

【００５９】カラーフィルタ１０の保護膜１６上（液晶層側）には、複数の第１の電極１０６が所定の間隔でストライプ状に形成されており、その上面を覆うように配向膜１０９が形成されている。一方、対向基板１０１におけるカラーフィルタ１０と対向する面上（液晶層側）には、カラーフィルタ１０側の第１の電極１０６と直交する方向に延在する複数の第２の電極１０５が、所定の間隔でストライプ状に形成され、その上面を覆うように配向膜１０７が形成されている。第１の電極１０６と第２の電極１０５とが交差する部位が画素であり、この画素となる部位に、カラーフィルタ１０の着色層１５ｒ、１５ｇ、１５ｂが位置するように構成されている。また、図示していないが、対向基板１０１およびカラーフィルタ１０の外面側には偏光板がそれぞれ設置されている。また、符号１０４は基板間の間隔（セルギャップという）を基板面内で一定に保持するためのスペーサであり、符号１１０は液晶組成物を基板間に保持するためのシール材である。尚、第１の電極１０６および第２の電極１０５はＩＴＯ（Indium Tin Oxide）などの透明導電材料を平面視ストライプ状に形成したものである。第１の電極１０６の一端部はシール材の外側まで延在するように形成され、引き回し配線１０６ａをなしている。

【００６０】かかる構成の液晶装置１００によれば、カラーフィルタ１０の保護膜１６が、インクジェットにより基板母材１１の全面に成膜された後に切断して形成されたものであるので、表面の平坦性に優れている。したがって、液晶装置１００におけるセルギャップのムラが小さく抑えられており、表示画面における輝度ムラが改善されて良好な表示が得られる。また、カラーフィルタ１０の保護膜１６の表面平坦性が良好であるので、その上層に形成されている第１の電極の表面平坦性および配向膜１０９の表面平坦性も良好なものとなる。したがって、配向膜１０９の表面段差に起因して生じるラビングムラが防止され、良好な液晶表示特性が得られる。さらに保護膜１６の形成にインクジェットを用いたので、スピンコート法で保護膜を形成する場合に比べて塗布液の使用量が少なくて済み、製造コストが削減される。

【００６１】図１０は、本実施形態のカラーフィルタ１０を用いて液晶装置を構成した第２の例を示したもので、パッシブマトリックス型液晶装置（液晶装置）の概略構成を示す断面図である。この実施形態の液晶装置２００に、液晶駆動用ＩＣ、バックライト、支持体などの付帯要素を装着することによって、最終製品としての透過型液晶表示装置が得られる。この液晶装置２００が、前記第１の例の液晶装置１００と大きく異なる点は、カラーフィルタ１０を下側（観測者側の反対側）に配置した点である。尚、本例において、カラーフィルタ１０の構成要素については、上記第１の例と同じ符号を付してその説明を省略する。

【００６２】この図には透過型液晶装置２００の要部を示しており、この液晶装置２００は、カラーフィルタ１０とガラス基板等からなる対向基板２０１との間にＳＴＮ（Super Twisted Nematic）液晶等からなる液晶層２０３が挟持されて概略構成されている。カラーフィルタ１０の保護膜１６上（液晶側）には、複数の第１の電極２０６が所定の間隔でストライプ状に形成されており、その上面を覆うように配向膜２０９が形成されている。一方、対向基板２０１のカラーフィルタ１０と対向する面上（液晶層側）には、カラーフィルタ側の第１の電極２０６と直交する方向に延在する複数の第２の電極２０５が、所定の間隔でストライプ状に形成され、その上面を覆うように配向膜２０７が形成されている。そして、第１の電極２０６と第２の電極２０５との交差する部位が画素であり、この画素となる部位に、カラーフィルタ１０の着色層１５ｒ、１５ｇ、１５ｂが位置するように構成されている。

【００６３】また、図示していないが、対向基板２０１およびカラーフィルタ１０の外面側には偏光板がそれぞれ設置されている。また、符号２０４は基板間の間隔（セルギャップという）を基板面内で一定に保持するためのスペーサであり、符号２１０は液晶を基板間に保持するためのシール材である。尚、第１の電極２０６および第２の電極２０５はＩＴＯ（Indium Tin Oxide）などの透明導電材料を平面視ストライプ状に形成したものである。かかる構成の液晶装置２００によれば、前記第１の例の液晶装置１００と同様の効果が得られ、液晶装置における輝度ムラおよびラビングムラの改善、低コスト化を実現することができる。

【００６４】図１１は、本実施形態のカラーフィルタ１０を用いて液晶装置を構成した第３の例を示したもので、透過型のＴＦＴ型（Thin Film Transistor 型）液晶装置３００の概略構成を示す分解斜視図である。この実施形態の液晶装置３００に、液晶駆動用ＩＣ、バックライト、支持体などの付帯要素を装着することによって、最終製品としての透過型液晶表示装置が構成される。この液晶装置３００は、前記第１の実施形態のカラーフィルタ１０を備えており、カラーフィルタ１０を上側（観測者側）に配置したものである。尚、本例において、カラーフィルタ１０の構成要素については、上記第１の例と同じ符号を付してその説明を省略する。

【００６５】この実施形態の液晶装置３００は、カラーフィルタ１０と、これに対向するように配置された対向基板３１４と、これらの間に挟持された図示しない液晶

層と、カラーフィルタ１０の上面側（観測者側）に付設された偏光板３１６と、対向基板３１４の下面側に付設された図示しない偏光板とを主体として構成されている。カラーフィルタ１０の保護膜１６上には液晶駆動用の電極３１８が形成されている。この電極３１８は、ＩＴＯ（Indium Tin Oxide）などの透明導電材料からなり、後述の画素電極３３２が形成される領域全体をカバーする全面電極とされている。また、電極３１８を覆って液晶層側に配向膜３１９が設けられている。

【００６６】一方、対向基板３１４上には絶縁層３２５が形成されており、絶縁膜３２５の上には、ＴＦＴ型のスイッチング素子と画素電極３３２が形成されている。なお、実際の液晶装置では、画素電極３３２上に配向膜が設けられるが、この図では省略している。

【００６７】スイッチング素子としての薄膜トランジスタＴ（ＴＦＴ）は、対向基板３１４上に形成された絶縁層３２５上に、マトリクス状に走査線３５１…と信号線３５２…とが形成され、これら走査線３５１…と信号線３５２…とに囲まれた領域毎に画素電極３３２が設けられ、各画素電極３３２のコーナ部分と走査線３５１と信号線３５２との間の部分に、ソース電極、ドレイン電極、半導体、およびゲート電極とを具備する薄膜トランジスタＴが組み込まれて構成されている。そして、走査線３５１と信号線３５２に対する信号の印加によって薄膜トランジスタＴをオン・オフして画素電極３３２への通電制御を行うことができるように構成されている。

【００６８】かかる構成の液晶装置３００によれば、前記第１の例の液晶装置１００と同様の効果が得られ、液晶装置における輝度ムラ、ラビングムラの改善、低コスト化を実現することができる。また上記の各例の液晶装置は、透過型の構成としたが、適宜の位置に反射層あるいは半透過反射層を設けて、反射型の液晶装置あるいは半透過反射型の液晶装置を構成することもできる。

【００６９】図１２は、カラーフィルタの第２の実施形態を示した部分断面図である。本実施形態のカラーフィルタ９０が前記第１の実施形態のカラーフィルタ１０と大きく異なる点は、着色層９５ｒ、９５ｇ、９５ｂがインクジェットを用いず、フォトリソグラフ法により形成されている点である。このカラーフィルタ９０は、基板９１ａ上に、マトリクス状に配された画素を備えており、画素と画素の境目は、遮光層からなるブラックマトリクス９２によって区切られている。１つ１つの画素にはＲ（赤）、Ｇ（緑）、Ｂ（青）のいずれかのインクからなる着色層９５ｒ、９５ｇ、９５ｂが形成されており、これらの全体を覆うように保護膜９６が形成されている。Ｒ、Ｇ、Ｂの配列は、いわゆるモザイク配列でもよく、ストライプ配列、デルタ配列など、その他の配列でも構わない。

【００７０】本実施形態のカラーフィルタ９０を製造するには、基板母材９１上にフォトリソグラフ法を用いて、ブラックマトリクス９２、次いでＲ（赤）、Ｇ（緑）、Ｂ（青）のインクからなる着色層９５ｒ、９５ｇ、９５ｂを順に形成した後、インクジェット法により保護膜９６を形成し、この後に、基板母材９１を個々のカラーフィルタ毎に切断すればよい。保護膜９６の形成は、前記第１の実施形態における保護膜形成装置５２、すなわち第４のインクジェット装置３４、第４の乾燥装置４４、および硬化装置４５と同様の装置を用い、前記第１の実施形態における保護膜１６の形成工程と同様の手順で行うことができる。本実施形態において、着色層９５ｒ、９５ｇ、９５ｂが形成された基板母材９１上に保護膜用塗布液Ｌを塗布するのにインクジェットを用いるので、単位面積当たりの塗布量を、基板母材９１の全面において均一としてもよく、あるいはブラックマトリクス９２上と着色層９５ｒ、９５ｇ、９５ｂ上とで塗布量を変えて膜厚を制御することも可能である。

【００７１】本実施形態においても、前記第１の実施形態と同様に、保護膜の表面段差Ｄを１μｍ以下に小さくすることができる。また保護膜の形成にインクジェットを用いているので、スピンコート法を用いる場合に比べて塗布液の使用量が少なくて済み、表面の平坦性に優れたカラーフィルタを低コストで製造することができる。また、本実施形態のカラーフィルタ９１も、前記第１の実施形態のカラーフィルタ１０と同様にして液晶装置を構成することができ、同様の作用効果を得ることができる。

【００７２】次に、本発明の電子機器の実施形態について説明する。図１３（ａ）は、携帯電話の一例を示した斜視図である。符号６００は携帯電話本体を示し、符号６０１は液晶表示部を示している。図１３（ｂ）は、ワープロ、パソコンなどの携帯型情報処理装置の一例を示した斜視図である。符号７００は情報処理装置、符号７０１はキーボードなどの入力部、符号７０３は情報処理装置本体を示し、符号７０２は液晶表示部を示している。図１３（ｃ）は、腕時計型電子機器の一例を示した斜視図である。符号８００は時計本体を示し、符号８０１は液晶表示部を示している。これらの電子機器において、液晶表示部６０１、７０２、８０１は、前記第１または第２のカラーフィルタ１０、９０のいずれかを備えた液晶装置、例えば前記第１～３の例の液晶装置１００、２００、３００のいずれかを用いて構成されている。

【００７３】これらの実施形態の電子機器にあっては、液晶表示部６０１、７０２、８０１が、保護膜の表面平坦性に優れたカラーフィルタ１０を備え液晶層のギャップの均一性に優れた液晶装置１００、２００、３００を用いて構成されているので、輝度ムラ等の表示不良が防止されて、良好な液晶表示が得られる

【００７４】

【実施例】（実施例１）図７に示す方法でカラーフィル

タ１０を製造した。まず、縦４７ｃｍ、横３７ｃｍ、厚さ０．７ｍｍの無アルカリガラスからなる基板母材１１を用意し、表面を熱濃硫酸に過酸化水素水を１重量％添加した洗浄液で洗浄し、純水でリンスした後、エア乾燥を行って表面を清浄化した。次に、清浄化された基板母材１１の表面に、スパッタ法により膜厚が平均０．２μｍのクロム薄膜を成膜した後、エッチングしてブラックマトリクス１２を形成した。基板母材１１上における複数のカラーフィルタ１０の配置は、周縁部に幅２０ｍｍの額縁状の余白を残して、その内側に縦２８ｍｍ、横３６ｍｍの有効領域が行列状に並ぶように配置した。また、縦方向において隣り合う有効領域の間隔は７ｍｍとし、横方向において隣り合う有効領域の間隔は６ｍｍとした。

【００７５】次いで、ブラックマトリクス１２が形成された基板母材１１上に、ネガ型のフッ素含有アクリル系の透明感光性樹脂組成物からなるレジスト層１７をスピンコート法により形成し、これを１００℃で２０分間加熱して予備乾燥させた後、所定のマトリクスパターン形状に形成されたマスクフィルム１８を密着させた状態で紫外線を照射して露光した。そして、アルカリ性の現像液に浸漬して、露光されていない部分のレジスト層を除去した後、純水によるリンス、スピン乾燥、熱硬化を順に行ってバンク１３を形成した。熱硬化させる際の加熱条件は２００℃で３０分間とした。バンク１３は、表面が疎インク性であり、高さは約２．５μｍとした。

【００７６】次に、ブラックマトリクス１２およびバンク１３からなる仕切り１４が形成された基板母材１１を第１のインクジェット装置３１に導入し、Ｒ（赤）の着色層１５ｒからなる画素が形成される領域（仕切り１４で囲まれた領域）に対して、インクジェットヘッド（図示略）から赤色のインクを吐出した。赤色のインクとしては、ポリウレタン樹脂オリゴマーに赤色の有機顔料を分散させた後、低沸点溶剤としてシクロヘキサノンおよび酢酸ブチルを、高沸点溶剤としてブチルカルビトールアセテートを加え、さらに非イオン系界面活性剤０．０１重量％を分散剤として添加し、粘度６～８ｍＰａ・ｓとしたものを用いた。この赤色インクのノズルプレートに対する接触角は４０．１°、表面張力は３０．８ｍＮ／ｍであった。この後、第１の乾燥装置４１に搬送し、ここでインクを乾燥させてＲ（赤）の着色層１５ｒを形成した。乾燥は、ホットプレートを用い、５０℃、３分間の加熱条件で行った。Ｒ（赤）の着色層１５ｒの高さ（乾燥後の膜厚）は１．２μｍとした。

【００７７】続いて、第２のインクジェット装置３２に導入し、Ｇ（緑）の着色層１５ｇからなる画素が形成される領域（仕切り１４で囲まれた領域）に対して、インクジェットヘッド（図示略）から緑色のインクを吐出した。緑色のインクとしては、上記で用いた赤色インクの組成において有機顔料を緑色のものに変更した他は同一成分とした、粘度６～８ｍＰａ・ｓのものを用いた。この緑色インクのノズルプレートに対する接触角は４０．５°、表面張力は３１．４ｍＮ／ｍであった。この後、第２の乾燥装置４２に搬送し、ここでインクを乾燥させてＧ（緑）の着色層１５ｇを形成した。乾燥は前記Ｒ（赤）の着色層１５ｒと同様に行った。Ｇ（緑）の着色層１５ｇの高さ（乾燥後の膜厚）は１．０μｍとした。

【００７８】続いて、第３のインクジェット装置３３に導入し、Ｂ（青）の着色層１５ｂからなる画素が形成される領域（仕切り１４で囲まれた領域）に対して、インクジェットヘッド（図示略）から青色のインクを吐出した。青色のインクとしては、上記で用いた赤色インクの組成において有機顔料を青色のものに変更した他は同一組成とした、粘度６～８ｍＰａ・ｓのものを用いた。この青色インクのノズルプレートに対する接触角は３９．８°、表面張力は３０．９ｍＮ／ｍであった。そして、第３の乾燥装置４３に搬送し、ここでインクを乾燥させてＢ（青）の着色層１５ｂを形成した。乾燥は前記Ｒ（赤）の着色層１５ｒと同様に行った。Ｂ（青）の着色層１５ｂの高さ（乾燥後の膜厚）は０．８μｍとした。この後、オーブン４６に搬送し、２２０℃、３０分間の条件でポストベークを行い、着色層１５ｒ，１５ｇ，１５ｂを硬化させた。

【００７９】続いて、着色層１５ｒ、１５ｇ、１５ｂが形成された基板母材１１に対してＡＰ処理（大気圧プラズマ処理）を施してバンク１３の表面を親インク化した後、第４のインクジェット装置３４に導入し、基板母材１１の着色層１５ｒ、１５ｇ、１５ｂが形成されている面全体に対して、保護膜用塗布液Ｌを塗布した。保護膜用塗布液Ｌとしては、アクリル系樹脂、エポキシ樹脂、カップリング剤、ジエチレングリコールジメチルエーテル（沸点１６２℃の溶剤）、およびブチルカルビトールアセテート（沸点２４７℃の溶剤）からなる熱硬化性樹脂組成物を用いた。この保護膜用塗布液Ｌの粘度は６ｍＰａ・ｓ、ノズルプレートに対する接触角は５０°、表面張力は２８ｍＮ／ｍであった。

【００８０】第４のインクジェット装置３４は、インクジェットヘッド群１を１スキャンさせることによって塗布可能な幅の最大値が１５２ｍｍとなるように構成した。そして、基板ステージ４上に基板母材１１を、基板母材１１の縦方向が進行方向Ｓとなるようにセットし、基板母材１１の角部から塗布を開始した。塗布時には、複数のノズル６７のうち同時に塗布液Ｌを吐出させるノズル６７の組み合わせを適宜設定することによって、１スキャンで形成される塗膜の端縁が、基板母材１１上におけるカラーフィルタの有効領域外に位置するように、塗膜の幅を制御した。具体的には、１スキャン目の塗布幅は１２６ｍｍとして基板母材１１の縦方向の一端から他端までを塗布し、次いで基板母材１１の横方向に改行して２スキャン目を行った。改行幅は、１スキャン目で

形成される塗膜のと２スキャン目で形成される塗膜との間に重なりや隙間ができないように設定し、２スキャン目の塗布幅は１２６ｍｍとした。同様にして３スキャン目の塗布を行って基板母材１１の全面上に保護膜用塗布液Ｌを塗布した。

【００８１】続いて、第４の乾燥装置４４に搬送し、ホットプレート乾燥により、基板母材１１上に塗布した保護膜用塗布液Ｌを予備乾燥させた。乾燥時の加熱条件は１００℃で５分間とした。さらに、硬化装置４５に導入して、２００℃３０分間の条件で加熱処理して塗膜を完全に硬化させ、保護膜１６を形成し、カラーフィルタ１０を得た。得られたカラーフィルタ１０について、表面段差を測定した。測定は、１個のカラーフィルタ上の２０箇所について表面段差の測定を行い、その２０箇所の平均値を求めた。その結果、保護膜１６の表面段差は約０．２９μｍであった。また、得られたカラーフィルタ１０を用いて、図１１に示す構成を有する透過型のＴＦＴ型液晶装置を製造した。得られた液晶装置を駆動させたところ、表示画面のエッジ部における干渉ムラは認められず、良好な表示が得られた。

【００８２】（比較例１）上記実施例１において、保護膜１６を基板母材１１の全面に設けず、カラーフィルタ１０の有効領域にのみ形成した他は同様にしてカラーフィルタを製造した。すなわち、上記実施例１と同様にして、基板薄材１１上に、ブラックマトリクス１２、バンク１３、および着色層１５ｒ、１５ｇ、１５ｂを形成した。続いて、ＡＰ処理を施してバンク１３の表面を親インク化した後、基板母材１１上においてカラーフィルタ１０の有効領域となる領域にのみ、インクジェット法により保護膜用塗布液Ｌを塗布した。保護膜用塗布液Ｌは上記実施例１と同じものを用いた。この後、上記実施例１と同様にして、塗膜の予備乾燥および熱硬化を行った後、基板母材１１を切断してカラーフィルタを得た。

【００８３】得られたカラーフィルタ１０について、上記実施例１と同様にして表面段差を測定した。その結果、保護膜１６の表面段差は約０．３０μｍであったが、上記実施例１と同様にして透過型のＴＦＴ型液晶装置に用いたところ、液晶装置を駆動させるときに表示画面の周縁部（エッジ部）に膜厚ムラが原因と思われる干渉縞が観察された。

【００８４】

【発明の効果】以上説明したように、本発明によれば、基板母材上に、インクジェット法により塗布した保護膜用塗布液を乾燥させる際に、塗膜のエッジ部に盛り上がりが生じても、基板母材を個々のカラーフィルタ毎に切断する際に、この盛り上がりが生じた部分を切り落とすことができるので、保護膜の表面平坦性に優れたカラーフィルタを製造することができる。また、従来のスピンコート法を用いて保護膜を形成する方法に比べて、使用する保護膜用塗布液の量が少なくて済むので、原材料費の削減、低コスト化を図ることができる。また本発明のカラーフィルタは、保護膜の表面段差が１μｍ以下であるので、表面平坦性が良好であり、このカラーフィルタを用いて液晶装置を構成することにより、カラーフィルタの上層に設けられる液晶層のギャップムラが防止され、輝度ムラ等の表示不良が抑えられて良好な液晶表示を得ることができる。したがって、本発明によれば、表示画面の均質性に優れた液晶装置および電子機器が得られる。

【図面の簡単な説明】

【図１】　本発明のカラーフィルタの第１の実施形態を示す部分断面図である。

【図２】　本発明のカラーフィルタの製造方法に好適に用いられる製造ラインの例を示す概略構成図である。

【図３】　本発明のカラーフィルタの製造方法に好適に用いられるインクジェット装置の例を示す概略構成図である。

【図４】　図２のインクジェット装置におけるインクジェットヘッドの配列の一例を示す平面図である。

【図５】　図２のインクジェット装置におけるインクジェットヘッドの要部断面斜視図である。

【図６】　図２のインクジェット装置におけるインクジェットヘッドの断面図である。

【図７】　（ａ）～（ｅ）は、第１の実施形態のカラーフィルタを製造する方法を工程順に示した模式断面図である。

【図８】　図２のインクジェット装置におけるインクジェットヘッドの配列の他の例を示す平面図である。

【図９】　本発明に係る液晶装置の例を示した断面図である。

【図１０】　本発明に係る液晶装置の例を示した断面図である。

【図１１】　本発明に係る液晶装置の例を示した分解斜視図である。

【図１２】　本発明のカラーフィルタの第２の実施形態を示す部分断面図である。

【図１３】　本発明に係る電子機器の例を示したもので（ａ）は携帯電話の斜視図であり、（ｂ）は携帯型情報処理装置の斜視図であり、（ｃ）は腕時計型電子機器の斜視図である。

【図１４】　従来のカラーフィルタの例を示す模式断面図である。

【図１５】　従来のカラーフィルタにおける表面段差を説明するための概略断面図である。

【符号の説明】

１０，９０…カラーフィルタ

１１，９１…基板母材

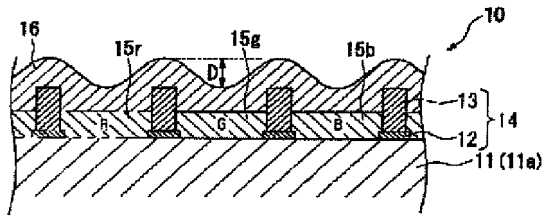
１１ａ，９１ａ，５０１…基板、

１５ｒ，１５ｇ，１５ｂ，９５ｒ，９５ｇ，９５ｂ，５０２ｒ，５０２ｇ，５０２ｂ…着色層、１６，９６，５

03…保護膜
1…インクジェットヘッド群
67…ノズル
72…インクジェットヘッド
L…保護膜用塗布液

100，200，300…液晶装置
101，201，314…対向基板
103，203…液晶層
D…表面段差

【図1】



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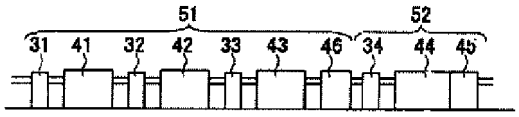

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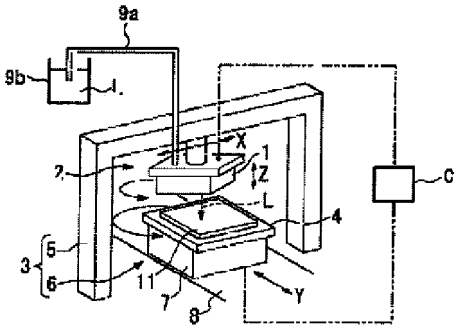

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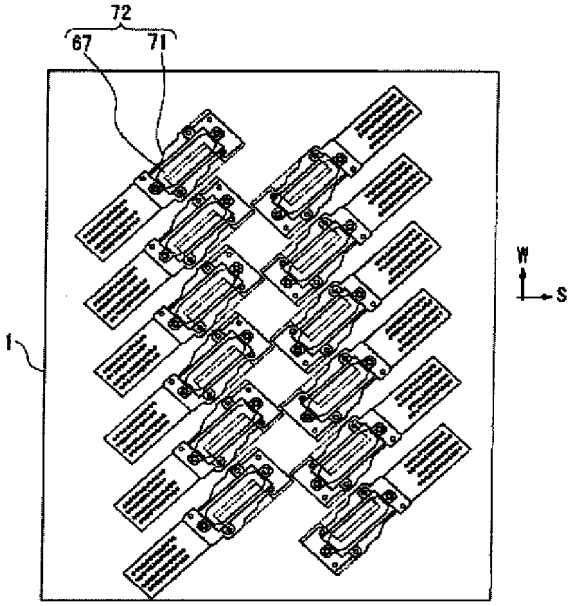

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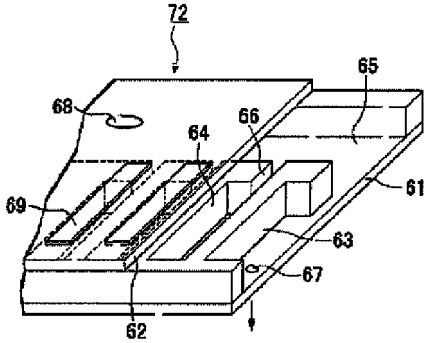

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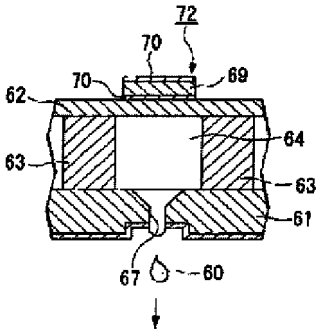

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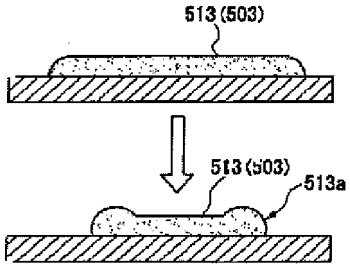

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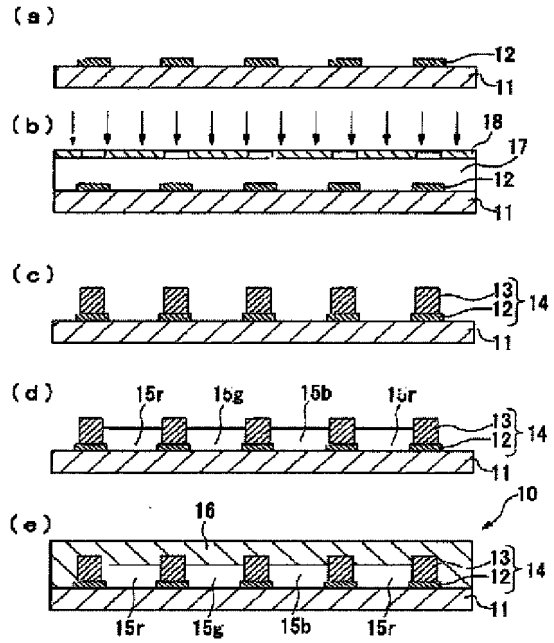

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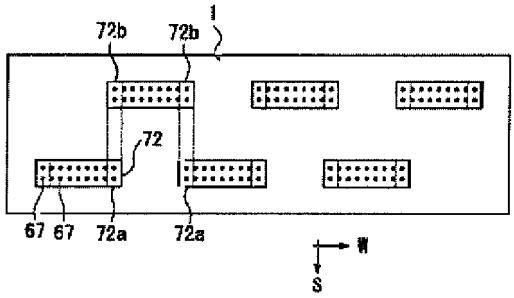

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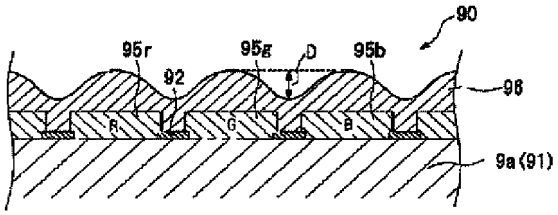

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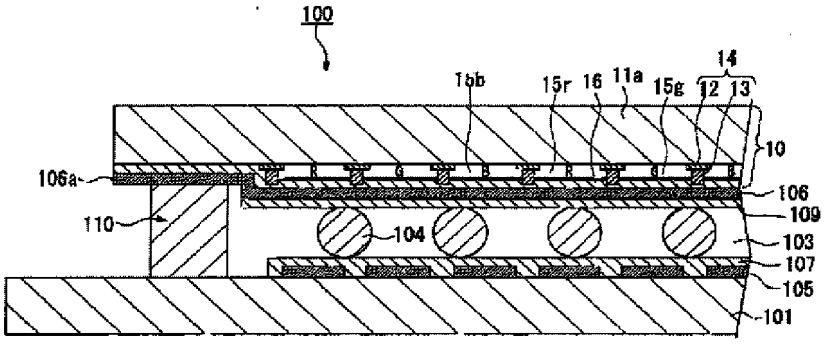
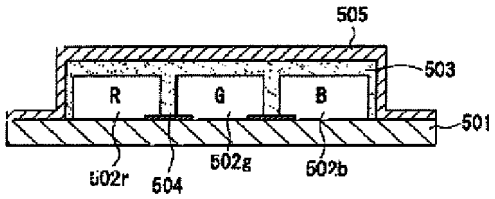
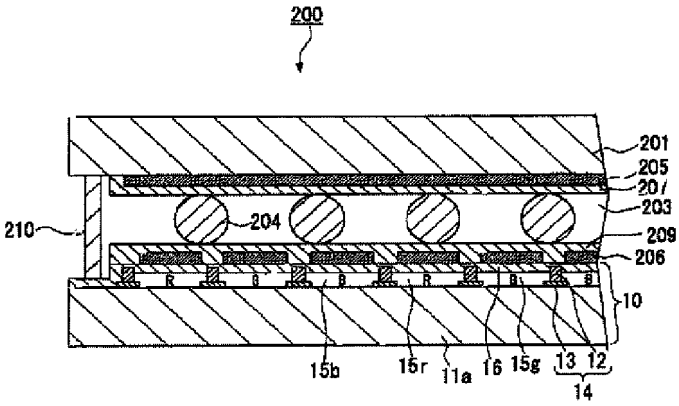


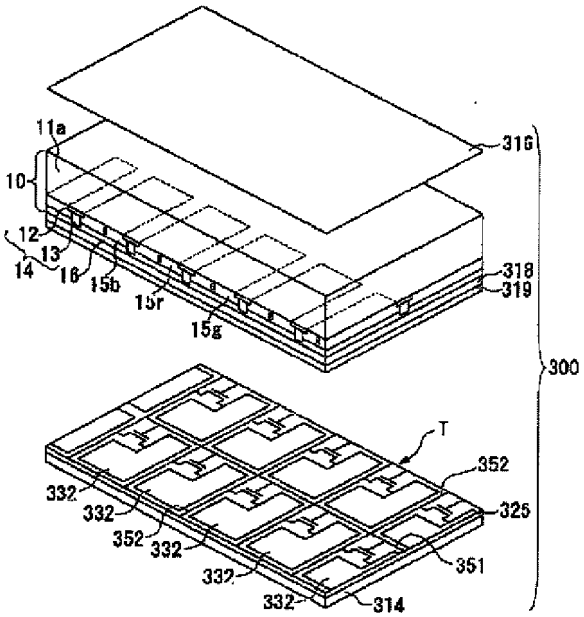
【図14】



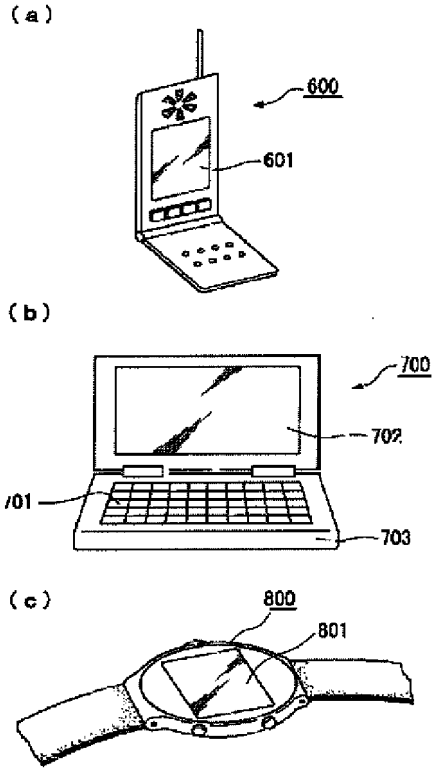
【図１０】



【図１１】



【図１３】



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LA15 LA18

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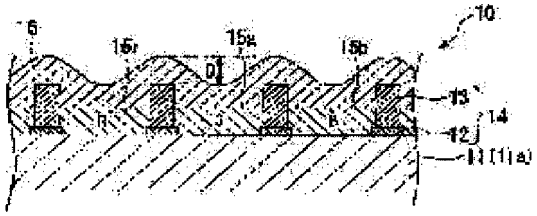
(54) COLOR FILTER AND METHOD FOR MANUFACTURING THE SAME, LIQUID CRYSTAL DEVICE AND ELECTRONIC APPLIANCE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve flatness of a protective film surface of a color filter and to provide a method for manufacturing the color filter excellent in the flatness of the protective film surface at a low cost.

SOLUTION: The method for manufacturing the color filter 10, comprising coloring layers 15r, 15g, 15b formed on a substrate 11a and the protective film 16 formed on the coloring layers 15r, 15g, 15b, includes: a coloring layer forming step to form the coloring layers 15r, 15g, 15b on a substrate base material 11 for cutting out a plurality of the substrates 11a, a step to apply a coating liquid for the protective film on a full surface of the substrate base material 11 of the side whereon the coloring layers 15r, 15g, 15b are formed with an inkjet method, a hardening step to harden the coating liquid for the protective film applied on the substrate base material 11 and to form the protective film 16 and a cutting step to cut the substrate base material 11 with the protective film 16 formed thereon for the individual color filters 10.



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[Date of extinction of right]	

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The coloring layer formation process which is the manufacture approach of a color filter of the coloring layer being formed on the substrate and coming to form a protective coat on this coloring layer, and forms a coloring layer on a substrate base material, The spreading process which applies the coating liquid for protective coats by the ink jet method on the whole surface of the field in which said coloring layer of said substrate base material is formed, The manufacture approach of the color filter characterized by having the hardening process which is made to harden the coating liquid for protective coats applied on said substrate base material, and forms a protective coat, and the cutting process which cuts said substrate base material with which said protective coat was formed for each color filter of every.
[Claim 2] the manufacture approach of the color filter according to claim 1 characterize by control the width of face of said paint film so that the edge of the cross direction of the paint film form with one scan may be locate outside the service area of a color filter , while make it move relatively and scan the location of said ink jet head and said substrate base material , breathe out said coating liquid for protective coats in said spreading process from two or more nozzles prepare in the ink jet head .
[Claim 3] The manufacture approach of the color filter according to claim 2 characterized by controlling the width of face to which said coating liquid for protective coats is applied by changing the combination of the nozzle with which the coating liquid for protective coats is breathed out by coincidence in said spreading process among two or more nozzles prepared in said ink jet head.
[Claim 4] The manufacture approach of the color filter according to claim 1 to 3 characterized by changing the coverage of the coating liquid for protective coats by the spreading field in said spreading process.
[Claim 5] The manufacture approach of a color filter according to claim 1 to 4 that said coloring layer formation process is characterized by having the process which applies the coating liquid for coloring layers by the ink jet method, and the process which stiffens this coating liquid for coloring layers, and performing this coloring layer formation process and the spreading process which applies said coating liquid for protective coats within one production line.
[Claim 6] The color filter which it is the color filter with which a coloring layer is formed on a substrate and it comes to form a protective coat on this coloring layer, and said protective coat is formed by the ink jet method, and is characterized by the surface level difference of this protective coat being 1 micrometer or less.
[Claim 7] After said protective coat forms a coloring layer on the substrate base material for cutting down a substrate, The coating liquid for protective coats is applied by the ink jet method on the whole surface of the field in which said coloring layer of this substrate base material is formed. The color filter according to claim 6 characterized by being formed by cutting said substrate base material for each color filter of every, and forming said protective coat on the whole surface of the substrate of a color filter after stiffening this coating liquid for protective coats.
[Claim 8] The color filter according to claim 7 characterized by the edge of the cross direction of the

paint film which spreading of said coating liquid for protective coats was performed by making it move relatively and scanning the location of said ink jet head and said substrate base material, breathing out the coating liquid for protective coats from two or more nozzles prepared in the ink jet head, and was applied with one scan existing outside the service area of a color filter.
[Claim 9] Liquid crystal equipment characterized by coming to have the liquid crystal constituent pinched between the color filter according to claim 6 to 8, the opposite substrate by which opposite arrangement was carried out at the side in which the protective coat of this color filter is formed, and said color filter and said opposite substrate.
[Claim 10] Electronic equipment characterized by coming to provide liquid crystal equipment according to claim 9.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a color filter, its manufacture approach, liquid crystal equipment, and electronic equipment.
[0002]
[Description of the Prior Art] In recent years, in electronic equipment, such as a notebook computer, a portable telephone, and an electronic notebook, liquid crystal equipment is widely used as a means to display information. Recently, the electrochromatic display equipment which has arranged the color filter to one substrate and enabled the full color display among the substrates of the pair which counters on both sides of a liquid crystal layer is in use. As shown in drawing 14 , the coloring layers 502r, 502g, and 502b of R (red), G (green), and B (blue) are formed on the front face of the transparence substrate 501 formed by glass, plastics, etc., and, as for the color filter, the protective coat 503 is formed if needed on it. The coloring layers 502r, 502g, and 502b of three colors constitute a pixel, respectively, and these are put in order in the array of a stripe array, a delta array, or a mosaic array. Moreover, between pixels, the black matrix 504 which consists of a protection-from-light layer is established. Furthermore, the transparent electrode layer 505 which consists of ITO film etc. is formed on a protective coat 503. A protective coat 503 is formed for the purpose, such as preventing the heat deterioration of the coloring layers 502r, 502g, and 502b in the process which forms the transparent electrode layer 505 which buries the surface level difference in the condition that the coloring layers 502r, 502g, and 502b were formed, and is made flat.
[0003] In order to manufacture the color filter of such a configuration, on the transparence substrate 501, a FOTORISO graphic method is used, and the black matrix 504 and after forming the coloring layers 502r, 502g, and 502b of R (red), G (green), and B (blue) subsequently, a protective coat 503 is formed first at the upper layer of the coloring layers 502r, 502g, and 502b of these three colors.
[0004] As the formation approach of a protective coat 503, there having been the approach of carrying out heat hardening and forming a protective coat 503, after applying coating liquid with a spin coat method, but this approach's having had much futility of coating liquid, and having un-arranged [to which a production cost becomes high], since the supplied coating liquid dispersed, although excelled in the point which makes the front face of a protective coat 503 flat. Moreover, in order to rotate a substrate at the time of spreading, there was an inclination for coating liquid to flow outside from the inside according to a centrifugal force, and for the thickness of a periphery field to become thick, consequently there was un-arranging [that dispersion in the thickness of a protective coat 503 became large]. The technique using the so-called ink jet is proposed in recent years for these cures.
[0005] For example, the approach of forming in JP,9-329707,A the protective coat 503 by which patterning was carried out by the ink jet method is indicated. This approach is the approach of heat-treating and stiffening by the ink jet method, after applying and carrying out predrying of the coating liquid for protective coat formation only on the service area of a color filter, as shown in drawing 14 .
[0006]
[Problem(s) to be Solved by the Invention] However, by this approach, in order that edge section 513a of the paint film 513 applied on the service area of a color filter might become thicker than

other parts and might rise so that it may illustrate to drawing 15 when predrying is performed, there was a problem that the front face of the protective coat 503 after hardening did not become flat. Thus, when the level difference had arisen on the front face of the protective coat 503 of a color filter and liquid crystal equipment was constituted using this color filter, there was a problem that gap nonuniformity will arise in the liquid crystal layer prepared in the protective coat 503 side of a color filter, and the brightness nonuniformity in the display screen will arise by it.

[0007] Therefore, the technical problem of this invention is to offer [offering the color filter excellent in the surface smoothness on the front face of a protective coat, and] the approach that the color filter excellent in the surface smoothness on the front face of a protective coat can be manufactured by low cost. Moreover, let it be a technical problem to offer the liquid crystal equipment and electronic equipment using a color filter of this invention.

[0008]

[Means for Solving the Problem] This invention is what solves at least one of said the technical problems. The manufacture approach of the color filter of this invention The coloring layer formation process which is the manufacture approach of a color filter of the coloring layer being formed on the substrate and coming to form a protective coat on this coloring layer, and forms a coloring layer on a substrate base material, The spreading process which applies the coating liquid for protective coats by the ink jet method on the whole surface of the field in which said coloring layer of said substrate base material is formed, It is characterized by having the hardening process which is made to harden the coating liquid for protective coats applied on said substrate base material, and forms a protective coat, and the cutting process which cuts said substrate base material with which said protective coat was formed for each color filter of every.

[0009] Since the coating liquid for protective coats is applied on the whole surface of a substrate base material according to the manufacture approach of this color filter, the edge section of a paint film turns into the periphery section of a substrate base material. Therefore, even if climax arises in the edge section of a paint film at the process which stiffens the coating liquid for protective coats, the periphery section of a substrate base material becomes thicker than the part of the inner direction. Therefore, if it designs so that the service area of each color filter may not be included in the periphery section of the substrate base material with which a paint film becomes thick on a substrate base material, the front face of a protective coat can be evenly formed in the service area of a color filter at least.

[0010] moreover , in said spreading process , the manufacture approach of the color filter of this invention be characterize by control the width of face of said paint film so that the edge of the cross direction of the paint film form with one scan may be locate outside the service area of a color filter , while it be make to move relatively and it scan the location of said ink jet head and said substrate base material , breathe out said coating liquid for protective coats from two or more nozzles prepare in the ink jet head .

[0011] In the spreading method using the usual ink jet, the field applied with the coating liquid breathed out by coincidence from the ink jet head equipped with two or more nozzles which carry out the regurgitation of the coating liquid is smaller than the spreading field of the whole which is finally going to form the paint film. Therefore, since the whole spreading field is applied moving an ink jet head (scan), on the boundary (line feed section) of a scan and a scan, a paint film tends to become an ununiformity. While making it move relatively and scanning the location of an ink jet head and a substrate base material, breathing out the coating liquid for protective coats from two or more nozzles prepared in the ink jet head according to the approach of this invention Since the width of face of said paint film is controlled so that the edge of the cross direction of the paint film formed with one scan is located outside the service area of a color filter, the boundary (line feed section) of a scan and a scan is formed outside the service area of a color filter, and a uniform paint film is formed in a service area. Here, the cross direction of a paint film is a perpendicular direction to the direction where an ink jet head advances relatively at the time of a scan.

[0012] As for control of the width of face to which the coating liquid for protective coats is applied, in this invention, it is desirable in said spreading process to carry out by changing the combination of the nozzle with which the coating liquid for protective coats is breathed out by coincidence among two or more nozzles prepared in said ink jet head. According to this approach, the width of face of

the paint film at the time of applying the coating liquid for protective coats by the ink jet method can be controlled easily and with high precision, and it can respond also to design changes, such as a substrate base material, easily.

[0013] Moreover, this invention can also change the coverage of the coating liquid for protective coats by the spreading field in said spreading process. In this invention, since an ink jet is used for formation of a protective coat, it is possible to change coverage according to the irregularity of the field which is going to form the protective coat, and the surface smoothness on the front face of a protective coat can be raised more by this.

[0014] Moreover, said coloring layer formation process has the process which applies the coating liquid for coloring layers by the ink jet method, and the process which stiffens this coating liquid for coloring layers, and can consider the manufacture approach of the color filter of this invention as the configuration which performs this coloring layer formation process and the spreading process which applies said coating liquid for protective coats within one production line. Since this approach uses an ink jet also for formation of a coloring layer and forms the protective coat using an ink jet within one production line succeeding this, when working efficiency can be raised, productivity can be raised and fertilization is realized, it is desirable.

[0015] The color filter of this invention is a color filter with which a coloring layer is formed on a substrate and it comes to form a protective coat on this coloring layer, and said protective coat is formed by the ink jet method, and it is characterized by the surface level difference of this protective coat being 1 micrometer or less.

[0016] In this invention, the surface level difference can be held down to 1 micrometer or less by forming the protective coat of a color filter by the ink jet method. If the surface level difference of the protective coat of a color filter is 1 micrometer or less, the homogeneity of the gap of a liquid crystal layer prepared in the protective coat side of a color filter will become good [the surface smoothness on the front face of a protective coat is good, and], when liquid crystal equipment is constituted using this color filter. A poor display, such as brightness nonuniformity which originates in the gap nonuniformity of a liquid crystal layer by this, is suppressed, and a good display is obtained.

[0017] After, as for the color filter of this invention, said protective coat forms a coloring layer on the substrate base material for cutting down a substrate, The coating liquid for protective coats is applied by the ink jet method on the whole surface of the field in which said coloring layer of this substrate base material is formed. After stiffening this coating liquid for protective coats, what was formed by cutting said substrate base material for each color filter of every is desirable. The manufactured color filter using this approach has the description that said protective coat is formed on the whole surface of the substrate of a color filter.

[0018] In case the color filter of this invention cuts a substrate base material since it is cut and obtained for each color filter of every after forming a protective coat on the whole surface of a substrate base material, it can cut off the climax produced in the edge section of a paint film at the time of protective coat formation. Therefore, the protective coat on the substrate of each color filter becomes the thing excellent in surface surface smoothness.

[0019] As for the color filter of this invention, what was performed by making it move relatively and scanning the location of said ink jet head and said substrate base material, spreading of said coating liquid for protective coats breathing out the coating liquid for protective coats from two or more nozzles prepared in the ink jet head is desirable, and if the approach of starting is used, the color filter with which the edge of the cross direction of the paint film applied with one scan exists outside the service area of a color filter will be obtained. If it is in the color filter of this configuration, since the ununiformity part of the paint film by line feed of an ink jet is not formed in the service area of a color filter, it becomes the thing equipped with the homogeneous protective coat excellent in surface surface smoothness.

[0020] It is characterized by the liquid crystal equipment of this invention coming to have the liquid crystal constituent pinched between the color filter of this invention, the opposite substrate by which opposite arrangement was carried out at the side in which the protective coat of this color filter is formed, and said color filter and said opposite substrate. Moreover, the electronic equipment of this invention is characterized by coming to provide the liquid crystal equipment of this invention.

[0021] Since the layer which turns into the upper layer of a protective coat from a liquid crystal constituent is prepared using the color filter excellent in the surface surface smoothness of a protective coat according to the liquid crystal equipment of this invention, it excels in the homogeneity of the gap of a liquid crystal layer. Therefore, a poor display, such as brightness nonuniformity resulting from gap nonuniformity, is suppressed, and a good display is obtained. Moreover, since the liquid crystal equipment which was equipped with the color filter excellent in the surface surface smoothness of a protective coat, and was excellent in the homogeneity of the gap of a liquid crystal layer is used according to the electronic equipment of this invention, a poor display, such as brightness nonuniformity, is prevented and a good liquid crystal display is obtained.
[0022]
[Embodiment of the Invention] Hereafter, the 1st operation gestalt concerning this invention is explained, referring to drawing 7 from drawing 1 . Drawing 1 is the fragmentary sectional view showing the color filter of this operation gestalt. This color filter 10 is equipped with the pixel allotted in the shape of a matrix on substrate 11a, and the boundary line of a pixel and a pixel is divided by the partition 14 which consists of a black matrix 12 which consists of a protection-from-light layer, and bank 13 formed on it. The coloring layers 15r, 15g, and 15b which consist of one ink of R (red), G (green), and B (blue) are formed in the pixel of each, and the protective coat 16 is formed so that these whole may be covered. The so-called mosaic array may be used for the array of R, G, and B, and it may also be other arrays, such as a stripe array and a delta array.
[0023] Drawing 2 is the outline block diagram showing the example of the production line used suitable to manufacture the color filter 10 of this operation gestalt. The production line of this example is equipped with the coloring stratification equipment 51 for performing the process which forms the coloring layers 15r, 15g, and 15b by the ink jet method, and the protective coat formation equipment 52 for performing the process which forms a protective coat 16 by the ink jet method, and the conveyance means is established among these equipments. coloring stratification equipment 51 -- the 1- it has the 3rd ink jet equipment 31, 32, and 33, and the 1st prepared in the latter part of each ink jet equipments 31, 32, and 33 - the 3rd dryer 41, 42, and 43, and the oven 46 for carrying out postbake of the ink is formed in the latter part of the 3rd dryer 43. Moreover, the conveyance means is established between each equipment. The 4th ink jet equipment 34, 4th dryer 44, and hardening equipment 45 are formed in order, and, as for protective coat formation equipment 52, the conveyance means is established between each equipment.
[0024] The approach of forming the coloring layers 15r, 15g, and 15b of a color filter 10 by the ink jet method is well-known (for example, JP,4-123007,A), and coloring stratification equipment 51 can be constituted, using suitably known ink jet equipment and a known dryer.
[0025] The top view in which drawing 3 thru/or drawing 6 show the example of the 4th ink jet equipment 34, drawing 3 shows the outline block diagram of ink jet equipment 34, and drawing 4 shows the array of the ink jet head 72, drawing 5 , and drawing 6 are the explanatory views of an ink jet 72. This 4th ink jet equipment 34 is equipped with the control section C which controls the movable migration device 3, and the ink jet device 2 and the migration device 3 for the location of the ink jet head group 1 equipped with two or more ink jet heads 72 which carry out the regurgitation of the coating liquid L for protective coats to the substrate base material 11 top, the ink jet device 2, and the ink jet head group 1 and the substrate base material 11 relatively.
[0026] The above-mentioned migration device 3 consists of a head supporter 5 which makes it move it to the location of arbitration to the substrate base material 11 while supporting the ink jet head group 1 above the substrate base material 11 laid on the substrate stage 4 so that the nozzle 67 of the ink jet head 72 may turn to a lower part, and a stage mechanical component 6 to which the substrate base material 11 is moved with the substrate stage 4 to the upper ink jet head group 1.
[0027] The above-mentioned head supporter 5 made the horizontal direction (X-axis) and the perpendicular direction (Z-axis) rotate the ink jet head group 1 for the ink jet head group 1 with the passing speed of arbitration the device of the linear motor in which ********** in movable is possible, and focusing on a perpendicular medial axis, and is equipped with the device of the stepping motor which can be set as arbitrary include angles to the downward substrate base material 11.
[0028] The above-mentioned stage mechanical component 6 rotated the substrate stage 4 focusing on

the perpendicular medial axis, and is equipped with theta shaft stage 7 which can be set as arbitrary include angles, and the Y-axis stage 8 in which ********** in movable is possible to horizontally (Y-axis) the substrate stage 4 is intersected perpendicularly in the direction of horizontal migration of the ink jet head group 1 to the upper ink jet head group 1. In addition, theta shaft stage 7 consists of stepping motors etc., and the Y-axis stage 8 consists of linear motors etc.

[0029] The above-mentioned ink jet device 2 is equipped with tank 9b which stores the coating liquid L for protective coats, in order to connect with the ink jet head group 1 through tube 9a and to supply the coating liquid L for protective coats to the ink jet head 72 of this ink jet head group 1. That is, spreading is performed by filling up the ink jet head 72 of the ink jet head group 1 with the coating liquid L for protective coats through tube 9a from tank 9b. It has the regurgitation device in which compress a liquid room and a liquid is made to breathe out by the pressure wave by the piezo-electric element, and the above-mentioned ink jet head 72 has two or more nozzles 67 arranged by a single tier or two or more trains.

[0030] Drawing 4 is what showed the example of the array of the nozzle 67 in the ink jet head group 1, and is drawing which carried out plane view of the inferior surface of tongue (field which counters the substrate stage 4) of the ink jet head group 1. In this example, 12 ink jet heads 72 equipped with the nozzle 67 and the regurgitation device 71 of a predetermined number (six piece x2 train) are formed in the ink jet head group 1. If the ink jet head group 1 sets to S the direction which advances relatively to the substrate base material 11 on the substrate stage 4 and makes a direction perpendicular to this direction the cross direction W It is parallel to a travelling direction S so that 12 ink jet heads 72 may make a train along the one direction where a nozzle 67 has the include angle of arbitration to a travelling direction S, and it is arranged so that the straight line which passes along each nozzle 67 may serve as regular intervals in the cross direction W. Although the number of the nozzles 67 prepared in one ink jet head 72 and the number of the ink jet heads 72 can be changed suitably, it is set up so that the width of face (magnitude in the cross direction W) which can be applied to coincidence by the coating liquid breathed out from two or more nozzles 67 prepared in the ink jet head group 1 may become larger than the magnitude of the service area of one color filter 10.

[0031] The structure of each ink jet head 72 is equipped with the nozzle plate 61 and diaphragm 62 made from stainless steel as shown in drawing 5 and drawing 6 , and both are joined through the batch member (reservoir plate) 63. Between the nozzle plate 61 and the diaphragm 62, two or more space 64 and liquid reservoirs 65 are formed of the batch member 63. The interior of each space 64 and a liquid reservoir 65 is filled with the coating liquid L for protective coats, and each space 64 and a liquid reservoir 65 are opening it for free passage through a feed hopper 66. Furthermore, the nozzle 67 which serves as a hole for injecting the coating liquid L for protective coats from space 64 is formed in the nozzle plate 61. On the other hand, the hole 68 for supplying the coating liquid L for protective coats to a liquid reservoir 65 is formed in the diaphragm 62.

[0032] Moreover, on the field which counters the space 64 of a diaphragm 62, and the field of the opposite side, the piezoelectric device (piezo-electric element) 69 is joined. This piezoelectric device 69 is located between the electrodes 70 of a pair, and if it energizes, it will bend so that a piezoelectric device 69 may project outside, and the diaphragm 62 with which the piezoelectric device 69 is joined to coincidence will also be united, and it will bend outside. The volume of space 64 increases by this. Therefore, the coating liquid L for protective coats equivalent to a part for the volume which increased in space 64 flows through a feed hopper 66 from a liquid reservoir 65. Next, if the energization to a piezoelectric device 69 is canceled, both a piezoelectric device 69 and the diaphragm 62 will return to the original configuration. Thereby, since space 64 also returns to the original volume, the pressure of the coating liquid L for protective coats of the space 64 interior rises, and the drop 60 of the coating liquid L for protective coats is breathed out towards the substrate base material 11 from a nozzle 67. In addition, methods other than the piezo jet type using the above-mentioned piezoelectric device as an ink jet method of the ink jet head 72 may be used, for example, it does not matter even if it adopts methods, such as an ink blowing pressure force jet method (for example, bubble jet (trademark) method) using the electric thermal-conversion object as an energy generation component.

[0033] The above-mentioned control section C is a computer which has the I/O function of CPUs,

such as a microprocessor which controls the whole equipment, or various signals, and it connects with the ink-jet device 2 and the migration device 3 electrically, respectively, and it has the function control either [at least] discharging by the ink jet device 2, or the migration actuation by the migration device 3, and change the spreading conditions of the coating liquid L for protective coats.
[0034] In this operation gestalt, the control section C is equipped with the function to change the combination of the nozzle 67 with which the coating liquid L for protective coats is breathed out by coincidence among two or more nozzles 67, in each ink jet head 72. Thereby, the regurgitation location of the coating liquid L in the ink jet head 72 can be changed, and when moving the ink jet head group 1 to a travelling direction S once, the width of face by which the coating liquid L for protective coats is applied on (1 Scan) and the substrate base material 11 can be controlled. Moreover, it is parallel to the travelling direction S of the ink jet head group 1, and if it controls so that the number of nozzles 67 with which the coating liquid L for protective coats is breathed out by coincidence on the straight line about all of the straight lines which pass along a nozzle 67 becomes equal, it is desirable when making coverage into homogeneity.
[0035] Furthermore, it is desirable to have the function in which a control section C can control coverage by the field where the coating liquid L for protective coats is applied. For example, it is desirable to prepare the control function which is repeated in case it applies to the same location on the control function which changes the discharge quantity from each nozzle 67 according to an individual, and/or the substrate base material 11 repeatedly and which sets up spreading conditions for every spreading, and to suppose that it is controllable so that the part where thickness differs may exist also in the paint film applied with one scan. Coverage is changed according to the shape of toothing of the front face of the substrate base material 11 just before applying this configuration, then the coating liquid L for protective coats, and it becomes possible to make still smaller the surface level difference D of a protective coat 16.
[0036] Drawing 7 (a) - (e) is the type section Fig. having shown how to manufacture the color filter 10 of this operation gestalt, in order of the process. First, the substrate base material 11 of the magnitude which can start two or more substrate 11a of one color filter 10 is prepared, and as shown in drawing 7 (a), the black matrix 12 is formed on the substrate base material 11. Although a glass substrate is generally used, if it has properties needed in the application as a color filter, such as transparency and a mechanical strength, as a substrate base material 11, ingredients other than glass can also be used.
[0037] The black matrix 12 is formed with the layered product of a chromium metal, a chromium metal, and chromic oxide, or resin black. In order to form the black matrix 12 which consists of a metal thin film, a spatter and vacuum deposition can be used. Moreover, in order to form the black matrix 12 which consists of a resin thin film, gravure, the photoresist method, a hot printing method, etc. can be used.
[0038] Then, bank 13 is formed on the black matrix 12. That is, as shown in drawing 7 (b), where the mask film 18 which formed the resist layer 17 which consists of a transparent photopolymer constituent of a negative mold, and was formed in the top face at the matrix pattern configuration is stuck, exposure processing is performed so that the substrate base material 11 and the black matrix 12 may be covered. And as shown in drawing 7 (c), by carrying out etching processing of the part for the unexposed part of the resist layer 17, patterning of the resist layer 17 is carried out, and bank 13 is formed. In a next process, in case this bank 13 and the black matrix 12 under it form the coloring layers 15r, 15g, and 15b by the ink jet method, they serve as the partition 14 which plays the role of the bank which regulates the breadth of ink.
[0039] Since the impact location precision of ink at the time of forming the coloring layers 15r, 15g, and 15b at a next process on the substrate base material 11 surrounded by the ink jet method on the bank 13 since a glass substrate (substrate base material 11) front face is parent ink nature when the resin ingredient with which a paint film front face serves as non-dense ink nature is used as an ingredient which forms bank 13 improves, it is desirable. In addition, in this case, after the coloring layers 15r and 15g and 15b formation, before forming a protective coat 16, it is desirable to form the top face of bank 13 into parent ink, and it is desirable to form the equipment for it between coloring stratification equipment 51 and protective coat formation equipment 52.
[0040] Next, as shown in drawing 7 (d), the coating liquid for coloring layers (ink) is applied to the

inside of the field surrounded by the partition 14, i.e., a pixel, this is dried, and the coloring layers 15r, 15g, and 15b are formed. this operation gestalt -- the 1- the coloring layers 15r, 15g, and 15b of three colors are formed in order using coloring stratification equipment 51 equipped with the 3rd ink jet equipment 31, 32, and 33. The formation sequence of the coloring layers 15r, 15g, and 15b of three colors is not limited.

[0041] For example, the substrate base material 11 with which the partition 14 was formed is first introduced into the 1st ink jet equipment 31, and the regurgitation of the red ink is carried out from an ink jet head (illustration abbreviation) only to the field in which the pixel which consists of coloring layer 15r of R (red) among many pixels is formed. Then, it conveys to the 1st dryer 41, ink is dried here, and coloring layer 15r of R (red) is formed. Then, the substrate base material 11 with which coloring layer 15r of R (red) was formed is conveyed to the 2nd ink jet equipment 32, and the regurgitation of the green ink is carried out from an ink jet head (illustration abbreviation) only to the field in which the pixel which consists of 15g of coloring layers of G (green) among many pixels is formed. And it conveys to the 2nd dryer 42, ink is dried here, and 15g of coloring layers of G (green) is formed. Then, the substrate base material 11 with which 15g of coloring layers of coloring layer 15r and G (green) of R (red) was formed is conveyed to the 3rd ink jet equipment 33, and the regurgitation of the blue ink is carried out from an ink jet head (illustration abbreviation) only to the field in which the pixel which consists of coloring layer 15b of B (blue) among many pixels is formed. Then, it conveys to the 3rd dryer 43, ink is dried here, and coloring layer 15b of B (blue) is formed. in addition, the 1- in case the black matrix 12 is formed so that the substrate base material 11 can be positioned in the 3rd ink jet equipment 31 and 32 and 33 at a precision for example, it is desirable to form the mark for alignment.

[0042] Viscosity is 2 - 20 mPa-s, the ink which forms the coloring layers 15r, 15g, and 15b has a contact angle larger than 50 degrees over a nozzle plate, and that [its] whose surface tension is 20 - 40 mN/m is desirable. There is a possibility of supply of the next ink after ink breathes out not meeting the deadline, and starting the poor regurgitation if the viscosity of ink is too high, and when viscosity is too low, there is a possibility that a fluidity may be too good and may serve as fault supply of ink. Moreover, if the contact angle over the nozzle plate of ink is too low, in case a nozzle plate will get wet in ink and an ink droplet will be breathed out, an ink droplet can draw near to the ink adhering to a nozzle plate, and there is a possibility that it may not be breathed out in an exact location. Moreover, even if too small [the surface tension of ink is too large, and], the stable meniscus control by vibration of a piezoelectric device becomes impossible. For example, an acrylic resin color paste, an aquosity melamine color paste, etc. can be used.

[0043] Although a difference has the thickness of the coloring layers 15r, 15g, and 15b by each class of RGB, it considers as within the limits of 0.8-1.2 micrometers in general. It is a 30-80-degree C temperature requirement, as for the process which dries ink, it is desirable to carry out the condition for 3 - 5 minutes, and it is desirable to set up the 3rd configuration of the 1st - dryers 41, 42, and 43, conveyance conditions, etc. so that these conditions may be suited. Moreover, after forming the coloring layers 15r, 15g, and 15b of three colors, oven 46 performs postbake (this baking) and ink is stiffened. The heating conditions at this time are preferably set as 220 degrees C and a 30-minute about room.

[0044] Then, as shown in drawing 7 (c), a protective coat 16 is formed so that the top face of the substrate base material 11, partition 14, and the coloring layers 15r, 15g, and 15b may be covered. Namely, the substrate base material 11 with which the coloring layers 15r, 15g, and 15b were formed It is conveyed to protective coat formation equipment 52. With the 4th ink jet equipment 34 Coloring layer 15r of the substrate base material 11, After the coating liquid L for protective coats is applied to the whole field in which 15g and 15b are formed and predrying is carried out with the 4th dryer 44, this coating liquid L is hardened with hardening equipment 45, and a protective coat 16 is formed.

[0045] Like the ink which fulfills the property required of the application as a protective coat as coating liquid L for protective coats, and forms the coloring layers 15r, 15g, and 15b by the ink jet although it is usable if spreading is possible, viscosity is 2-20mPa, the contact angle over a nozzle plate is more preferably larger than 50 degrees 35 degrees or more, and that whose surface tension is 20 - 40 mN/m is desirable. Moreover, in case an ingredient is selected, what has the good leveling

nature to which the front face after spreading becomes flat promptly, and what has the good wettability to a spreading side are desirable, and, as for especially a solvent, what has the next good drying method and the compatibility in a desiccation process is desirable. Moreover, an additive uses what does not degrade the property of a protective coat. Although it can be changed by changing combination of a solvent, when the cure rate of the coating liquid L for protective coats has a too quick cure rate, before flattening of the applied paint film is carried out, it is hardened, and has a possibility that the surface smoothness of protective coat 16 front face may worsen. On the contrary, if a cure rate is too slow, since the drying time will start for a long time, productivity worsens.

[0046] As this coating liquid L for protective coats, it consists of 10 - 20 % of the weight of acrylic resin, 0.1 - 3 % of the weight of epoxy resins, 0.1 - 3 % of the weight of coupling agents, 35 - 60 % of the weight (solvent of 162 degrees C of boiling points) of diethylene-glycol wood ether, and 20 - 45 % of the weight (solvent of 247 degrees C of boiling points) of butyl carbitol acetate, and the thermosetting resin constituent which is 46-52 degrees of contact angles, the surface tension 25 - 29 mN/m to viscosity 4 - 8 mPa-s, and a nozzle plate can be used preferably, for example.

[0047] The effectiveness which will bury the level difference of partition 14 and the coloring layers 15r, 15g, and 15b, and will carry out flattening of the front face if the thickness of the protective coat 16 after desiccation is too thin is not fully acquired, but if too thick, starting productivity will become [the drying time] long bad. In this operation gestalt, generally the level difference of the partition 14 and the coloring layers 15r, 15g, and 15b just before forming a protective coat 16 is about 1.5-1.8 micrometers, and, as for the thickness of a protective coat 16 which buries this, it is desirable to be referred to as about 3.0-4.0 micrometers after hardening.

[0048] In order to apply the coating liquid L for protective coats with the 4th ink jet equipment 34, the ink jet head group 1 and/or the substrate stage 4 are moved so that the substrate base material 11 may be set and the ink jet head group 1 may be first located above the spreading starting position of the substrate base material 11 on the substrate stage 4. Subsequently, making the coating liquid L for protective coats breathe out at intervals of the predetermined regurgitation from the ink jet head 72 of the ink jet head group 1, the substrate stage 4 is moved in the direction of Y, and 1 scan eye is applied. In this case, the relative travelling direction S of the ink jet head 72 turns into the direction of Y. And making the coating liquid L for protective coats **** at intervals of the predetermined regurgitation from the ink jet head 72 again, after starting a new line by moving the ink jet head group 1 in the direction of X, the substrate stage 4 is moved in the direction of Y, and 2 scan eye is applied. Thus, the coating liquid L for protective coats is applied all over the substrate base material 11, repeating line feed of a scan. Or making the coating liquid L for protective coats **** from the ink jet head 72 of the ink jet head group 1, the ink jet head group 1 is moved in the direction of X, 1 scan may be applied and the substrate stage 4 may be moved in the direction of Y at the time of line feed. In this case, the relative travelling direction S of the ink jet head 72 turns into the direction of X.

[0049] Width of face of the paint film formed with one scan is made larger than the service area of one color filter 10, and it applies so that the edge of the cross direction of the paint film formed with one scan may be located outside the service area of a color filter. Moreover, it is desirable to control coverage so that desired thickness is obtained. The coverage per unit area is good also as homogeneity on the whole surface of the substrate base material 11, or may change coverage by the part according to the irregularity of the front face of the substrate base material 11 just before applying the coating liquid L for protective coats. For example, since partition 14 differs in height from the coloring layers 15r, 15b, and 15c, if it controls to change the discharge quantity at the time of carrying out the regurgitation of the coating liquid L for protective coats to each top face, the surface smoothness of the front face of a protective coat 16 can be raised more.

[0050] Specifically, thickness is controllable by changing the discharge quantity of the coating liquid L from each nozzle 67 by the control section C. That is, the coverage per unit area changes in proportion to discharge quantity, and if discharge quantity is increased, while being able to thicken thickness, thickness can be made thin if discharge quantity is reduced. Or in case it applies to the same location on the substrate base material 11 repeatedly, the thickness of a paint film can be controlled also by [repeating] controlling the discharge quantity of the coating liquid L from each above-mentioned nozzle 67 for every spreading, respectively.

[0051] Known technique, such as the spin drying method, the hot plate drying method, and a vacuum-drying method, can be suitably used for the process to which predrying of the paint film of the coating liquid for protective coats is carried out with the 4th dryer 44. It is desirable to adopt the proper drying method according to the surface state of the paint film before desiccation not only by the condition of the paint film before desiccation but by the difference in the drying method, taking into consideration a result of protective coat 16 front face, productivity, etc., since the surface surface smoothness of the protective coat 16 after desiccation may change.
[0052] By heat-treating with hardening equipment 45 equipped with heating means, such as oven equipped with the warm air blower style for the substrate base material 11 after predrying, the process which stiffens the paint film after predrying with hardening equipment 45 stiffens a paint film, and let it be a protective coat 16. The conditions at the time of heating are suitably set up according to an ingredient, thickness, etc. of a paint film.
[0053] Thus, after forming a protective coat 16, a color filter 10 is obtained by cutting the substrate base material 11 for each service area of every. Moreover, it is desirable while assembling a liquid crystal panel, after assembling a liquid crystal panel using the substrate base material 11 in using this color filter 10 for liquid crystal equipment to cut the substrate base material 11 for every color filter.
[0054] According to this operation gestalt, the surface level difference D of a protective coat 16 can be made small to 1 micrometer or less. The value of the surface level difference D here means the value of the difference of the upper limit when measuring a front face with a contact process level difference measuring device, and a lower limit. Moreover, since the ink jet method is used for formation of a protective coat 16, compared with the case where a spin coat method is used, there is little amount of the coating liquid used, it ends, and the color filter excellent in surface surface smoothness can be manufactured by low cost.
[0055] In addition, although the ink jet head group 1 which considered as the means which carries out the regurgitation of the coating liquid L in ink jet equipment, and was equipped with two or more ink jet heads 72 was used with this operation gestalt, if the paint film of desired width of face is obtained with one scan, it is also possible to constitute a regurgitation means only from one ink jet head. Like this operation gestalt, if a regurgitation means is constituted using two or more ink jet heads 72, the existing small ink jet head can be used, and it can constitute so that a paint film with comparatively wide width of face may be obtained with one scan.
[0056] Moreover, the array of the ink jet head 72 in the ink jet head group 1 is making the train along the one direction where not only the array of this operation gestalt but the nozzle 67 has the include angle of arbitration to a travelling direction S, and is parallel to a travelling direction S, and can be considered as a proper array that what is necessary is to just be arranged so that the straight line which passes along each nozzle 67 may serve as regular intervals in the cross direction W. For example, two or more [to the cross direction W / head / 72 / ink jet], as shown in drawing 8 , in the example of this drawing, each ink jet head 72 may be arranged with 2 successive-installation **** to three pieces and a travelling direction S so that a nozzle 67 may make a train along the cross direction W. In edge 72a of the cross direction W of the ink jet head 72 of eye one train, it is parallel to a travelling direction S, and in edge 72b of the cross direction W of the straight line which passes along a nozzle 67, and the ink jet head 72 of eye two trains, it is parallel to a travelling direction S, and, as for a part of straight line which passes along a nozzle 67, constituting so that it may lap is desirable. In addition, in this drawing, the regurgitation device of an ink jet head is omitting illustration.
[0057] Drawing 9 is what showed the 1st example which constituted liquid crystal equipment using the color filter 10 of this operation gestalt, and is the sectional view showing the outline configuration of passive matrix type liquid crystal equipment (liquid crystal equipment). The transparency mold liquid crystal display as a final product is obtained by equipping the liquid crystal equipment 100 of this example with incidental elements, such as IC for a liquid crystal drive, a back light, and a base material.
[0058] This liquid crystal equipment 100 is equipped with the color filter 10 explained with the 1st operation gestalt, and arranges a color filter 10 to the up side (watcher side). In addition, suppose that a color filter 10 is explained simple in this operation gestalt. The important section of transparency mold liquid crystal equipment 100 is shown in this drawing, between the opposite substrates 101

which consist of a color filter 10, a glass substrate, etc., the liquid crystal layer 103 which consists of a STN (Super Twisted Nematic) liquid crystal constituent etc. is pinched, and the outline configuration of this liquid crystal equipment 100 is carried out. A color filter 10 is the same as the color filter explained with the 1st operation gestalt, and is equipped with the partition 14 and the coloring layers 15r, 15g, and 15b which consist of substrate 11a, a black matrix 12, and bank 13, and a protective coat 16.

[0059] On the protective coat 16 of a color filter 10 (liquid crystal layer side), two or more 1st electrodes 106 are formed in the shape of a stripe at the predetermined spacing, and the orientation film 109 is formed so that the top face may be covered. On the other hand, on the color filter 10 in the opposite substrate 101, and the field which counters (liquid crystal layer side), two or more 2nd electrodes 105 which extend in the direction which intersects perpendicularly with the 1st electrode 106 by the side of a color filter 10 are formed in the shape of a stripe at the predetermined spacing, and the orientation film 107 is formed so that the top face may be covered. The part where the 1st electrode 106 and 2nd electrode 105 cross is a pixel, and it is constituted so that the coloring layers 15r, 15g, and 15b of a color filter 10 may be located in the part used as this pixel. Moreover, although not illustrated, the polarizing plate is installed in the external surface side of the opposite substrate 101 and a color filter 10, respectively. Moreover, a sign 104 is a spacer for holding uniformly in a substrate side spacing between substrates (it being called a cel gap), and a sign 110 is a sealant for holding a liquid crystal constituent between substrates. In addition, the 1st electrode 106 and 2nd electrode 105 form transparence electrical conducting materials, such as ITO (Indium Tin Oxide), in the shape of a plane view stripe. The end section of the 1st electrode 106 is formed so that it may extend to the outside of a sealant, and it is making leading-about wiring 106a.

[0060] Since according to the liquid crystal equipment 100 of this configuration the protective coat 16 of a color filter 10 cuts and is formed after membranes are formed by the ink jet all over the substrate base material 11, it excels in surface surface smoothness. Therefore, the nonuniformity of the cel gap in liquid crystal equipment 100 is stopped small, the brightness nonuniformity in the display screen is improved and a good display is obtained. Moreover, since the surface surface smoothness of the protective coat 16 of a color filter 10 is good, the surface surface smoothness of the 1st electrode currently formed in the upper layer and the surface surface smoothness of the orientation film 109 will also become good. Therefore, the rubbing nonuniformity which originates in the surface level difference of the orientation film 109, and is produced is prevented, and a good liquid crystal display property is acquired. Since the ink jet was furthermore used for formation of a protective coat 16, compared with the case where a protective coat is formed, there is little amount of the coating liquid used, it ends with a spin coat method, and a manufacturing cost is reduced.

[0061] Drawing 10 is what showed the 2nd example which constituted liquid crystal equipment using the color filter 10 of this operation gestalt, and is the sectional view showing the outline configuration of passive matrix type liquid crystal equipment (liquid crystal equipment). The transparency mold liquid crystal display as a final product is obtained by equipping the liquid crystal equipment 200 of this operation gestalt with incidental elements, such as IC for a liquid crystal drive, a back light, and a base material. The point that this liquid crystal equipment 200 differs from the liquid crystal equipment 100 of said 1st example greatly is a point which has arranged the color filter 10 to the down side (opposite side by the side of a watcher). In addition, in this example, about the component of a color filter 10, the same sign as the 1st example of the above is attached, and the explanation is omitted.

[0062] The important section of transparency mold liquid crystal equipment 200 is shown in this drawing, between the opposite substrates 201 which consist of a color filter 10, a glass substrate, etc., the liquid crystal layer 203 which consists of STN (Super Twisted Nematic) liquid crystal etc. is pinched, and the outline configuration of this liquid crystal equipment 200 is carried out. On the protective coat 16 of a color filter 10 (liquid crystal side), two or more 1st electrodes 206 are formed in the shape of a stripe at the predetermined spacing, and the orientation film 209 is formed so that the top face may be covered. On the other hand, on the color filter 10 of the opposite substrate 201, and the field which counters (liquid crystal layer side), two or more 2nd electrodes 205 which extend in the direction which intersects perpendicularly with the 1st electrode 206 by the side of a color filter are formed in the shape of a stripe at the predetermined spacing, and the orientation film 207 is

formed so that the top face may be covered. And the crossing part of the 1st electrode 206 and the 2nd electrode 205 is a pixel, and it is constituted so that the coloring layers 15r, 15g, and 15b of a color filter 10 may be located in the part used as this pixel.
[0063] Moreover, although not illustrated, the polarizing plate is installed in the external surface side of the opposite substrate 201 and a color filter 10, respectively. Moreover, a sign 204 is a spacer for holding uniformly in a substrate side spacing between substrates (it being called a cel gap), and a sign 210 is a sealant for holding liquid crystal between substrates. In addition, the 1st electrode 206 and 2nd electrode 205 form transparence electrical conducting materials, such as ITO (Indium Tin Oxide), in the shape of a plane view stripe. According to the liquid crystal equipment 200 of this configuration, the same effectiveness as the liquid crystal equipment 100 of said 1st example is acquired, and improvement of the brightness nonuniformity in liquid crystal equipment and rubbing nonuniformity and low cost-ization can be realized.
[0064] Drawing 11 is what showed the 3rd example which constituted liquid crystal equipment using the color filter 10 of this operation gestalt, and is the decomposition perspective view showing the outline configuration of the TFT mold (Thin Film Transistor mold) liquid crystal equipment 300 of a transparency mold. The transparency mold liquid crystal display as a final product is constituted by equipping the liquid crystal equipment 300 of this operation gestalt with incidental elements, such as IC for a liquid crystal drive, a back light, and a base material. This liquid crystal equipment 300 is equipped with the color filter 10 of said 1st operation gestalt, and arranges a color filter 10 to the up side (watcher side). In addition, in this example, about the component of a color filter 10, the same sign as the 1st example of the above is attached, and the explanation is omitted.
[0065] The liquid crystal equipment 300 of this operation gestalt is constituted considering a color filter 10, the opposite substrate 314 arranged so that this may be countered, the liquid crystal layer which was pinched among these and which is not illustrated, the polarizing plate 316 attached to the top-face side (watcher side) of a color filter 10, and the polarizing plate which was attached to the inferior-surface-of-tongue side of the opposite substrate 314 and which is not illustrated as a subject. On the protective coat 16 of a color filter 10, the electrode 318 for a liquid crystal drive is formed. This electrode 318 consists of transparence electrical conducting materials, such as ITO (Indium Tin Oxide), and let it be the whole surface electrode which covers the whole field in which the below-mentioned pixel electrode 332 is formed. Moreover, an electrode 318 is covered and the orientation film 319 is formed in the liquid crystal layer side.
[0066] On the other hand, the insulating layer 325 is formed on the opposite substrate 314, and the switching element and the pixel electrode 332 of a TFT mold are formed on the insulator layer 325. In addition, although the orientation film is prepared on the pixel electrode 332 with actual liquid crystal equipment, it is omitting in this drawing.
[0067] Thin film transistor T (TFT) as a switching element On the insulating layer 325 formed on the opposite substrate 314, signal-line 352 -- is formed with scanning-line 351 -- in the shape of a matrix. The pixel electrode 332 is formed for every field surrounded by signal-line 352 -- with these scanning-lines 351 --. Thin film transistor T possessing a source electrode, a drain electrode, a semi-conductor, and a gate electrode is incorporated and constituted by the part between the corner part of each pixel electrode 332, the scanning line 351, and a signal line 352. And it is constituted so that thin film transistor T may be turned on and off and energization control to the pixel electrode 332 can be performed by impression of a signal to the scanning line 351 and a signal line 352.
[0068] According to the liquid crystal equipment 300 of this configuration, the same effectiveness as the liquid crystal equipment 100 of said 1st example is acquired, and improvement of the brightness nonuniformity in liquid crystal equipment and rubbing nonuniformity and low cost-ization can be realized. Moreover, although the liquid crystal equipment of each above-mentioned example was considered as the configuration of a transparency mold, it can prepare a reflecting layer or a transflective reflection layer in a proper location, and can also constitute the liquid crystal equipment of a reflective mold, or the liquid crystal equipment of a transflective reflective mold.
[0069] Drawing 12 is the fragmentary sectional view having shown the 2nd operation gestalt of a color filter. The point that the color filter 90 of this operation gestalt differs from the color filter 10 of said 1st operation gestalt greatly is a point that the coloring layers 95r, 95g, and 95b are formed by the FOTORISO graphic method not using the ink jet. This color filter 90 is equipped with the pixel

allotted in the shape of a matrix on substrate 91a, and the boundary line of a pixel and a pixel is divided by the black matrix 92 which consists of a protection-from-light layer. The coloring layers 95r, 95g, and 95b which consist of one ink of R (red), G (green), and B (blue) are formed in the pixel of each, and the protective coat 96 is formed so that these whole may be covered. The so-called mosaic array may be used for the array of R, G, and B, and it may also be other arrays, such as a stripe array and a delta array.

[0070] What is necessary is to form a protective coat 96 by the ink jet method, and just to cut the substrate base material 91 for each color filter of every next, after using a FOTORISO graphic method and forming in order the black matrix 92 and the coloring layers 95r, 95g, and 95b which subsequently consist of ink of R (red), G (green), and B (blue) on the substrate base material 91, in order to manufacture the color filter 90 of this operation gestalt. The same procedure as the formation process of the protective coat 16 in said 1st operation gestalt can perform formation of a protective coat 96 using the protective coat formation equipment 52 34 in said 1st operation gestalt, i.e., the 4th ink jet equipment, the 4th dryer 44 and hardening equipment 45, and the same equipment. In this operation gestalt, since an ink jet is used for applying the coating liquid L for protective coats on the substrate base material 91 with which the coloring layers 95r, 95g, and 95b were formed, on the whole surface of the substrate base material 91, it is good also as homogeneity in the coverage per unit area, or it is also possible to change coverage on the coloring layers 95r and 95g and 95b the black matrix 92 top, and to control thickness.

[0071] Also in this operation gestalt, the surface level difference D of a protective coat can be made small like said 1st operation gestalt at 1 micrometer or less. Moreover, since the ink jet is used for formation of a protective coat, compared with the case where a spin coat method is used, there is little amount of the coating liquid used, it ends, and the color filter excellent in surface surface smoothness can be manufactured by low cost. Moreover, the color filter 91 of this operation gestalt as well as the color filter 10 of said 1st operation gestalt can constitute liquid crystal equipment, and the same operation effectiveness can be acquired.

[0072] Next, the operation gestalt of the electronic equipment of this invention is explained. Drawing 13 (a) is the perspective view having shown an example of a cellular phone. A sign 600 shows the body of a cellular phone, and the sign 601 shows the liquid crystal display section. Drawing 13 (b) is the perspective view having shown an example of pocket mold information processors, such as a word processor and a personal computer. An information processor and a sign 701 show the input sections, such as a keyboard, a sign 703 shows the body of an information processor, and, as for the sign 700, the sign 702 shows the liquid crystal display section. Drawing 13 (c) is the perspective view having shown an example of wrist watch mold electronic equipment. A sign 800 shows the body of a clock and the sign 801 shows the liquid crystal display section. In these electronic equipment, the liquid crystal display sections 601, 702, and 801 are constituted using either of liquid crystal equipment 100, 200, and 300 equipped with either of said 1st or 2nd color filter 10 and 90, for example, the liquid crystal equipments of said 1-3rd examples.

[0073] [0074] from which a poor display, such as brightness nonuniformity, is prevented and a good liquid crystal display is obtained since the liquid crystal display sections 601, 702, and 801 are constituted using the liquid crystal equipments 100, 200, and 300 which were equipped with the color filter 10 excellent in the surface surface smoothness of a protective coat, and were excellent in the homogeneity of the gap of a liquid crystal layer, if it is in the electronic equipment of these operation gestalten

[Example] (Example 1) The color filter 10 was manufactured by the approach shown in drawing 7 . First, the substrate base material 11 which consists of 47cm long, 37cm wide, and alkali free glass with a thickness of 0.7mm was prepared, after it washed the front face to heat concentrated sulfuric acid by the penetrant remover which added hydrogen peroxide solution 1% of the weight and it carried out the rinse to it with pure water, air desiccation was performed and the front face was defecated. Next, after thickness formed the chromium thin film which is an average of 0.2 micrometers by the spatter on the front face of the defecated substrate base material 11, it etched into it and the black matrix 12 was formed in it. Arrangement of two or more color filters 10 which can be set on the substrate base material 11 left the margin of the shape of a frame with a width of face of 20mm to the periphery section, and it has arranged it so that 28mm long and a 36mm wide service

area may be located in a line with the inside in the shape of a matrix. Moreover, spacing of the service area which adjoins each other in a lengthwise direction was set to 7mm, and spacing of the service area which adjoins each other in a longitudinal direction was set to 6mm.

[0075] Subsequently, the resist layer 17 which consists of a transparence photopolymer constituent of fluorine content acrylic of a negative mold was formed with the spin coat method on the substrate base material 11 with which the black matrix 12 was formed, and after it heated this for 20 minutes and it carried out predrying at 100 degrees C, where the mask film 18 formed in the predetermined matrix pattern configuration is stuck, ultraviolet rays were irradiated and were exposed. And after being immersed in the alkaline developer and removing the resist layer of the part which is not exposed, the rinse by pure water, spin desiccation, and heat curing were performed in order, and the bank 13 was formed. The heating conditions at the time of carrying out heat curing were set as for 30 minutes at 200 degrees C. A front face is non-dense ink nature, and height set the bank 13 to about 2.5 micrometers.

[0076] Next, the substrate base material 11 with which the partition 14 which consists of a black matrix 12 and bank 13 was formed was introduced into the 1st ink jet equipment 31, and red ink was breathed out from the ink jet head (illustration abbreviation) to the field (field surrounded by the partition 14) in which the pixel which consists of coloring layer 15r of R (red) is formed. As red ink, after making polyurethane resin oligomer distribute a red organic pigment, a cyclohexanone and butyl acetate were added as a low boiler, butyl carbitol acetate was added as a high boiler, 0.01 % of the weight of non-ion system surfactants was further added as a dispersant, and what was made into viscosity 6 - 8 mPa-s was used. The contact angle over the nozzle plate of this red ink was 40.1 degrees, and surface tension was 30.8 mN/m. Then, it conveyed to the 1st dryer 41, ink was dried here, and coloring layer 15r of R (red) was formed. Desiccation was performed on 50 degrees C and the heating conditions for 3 minutes using the hot plate. The height (thickness after desiccation) of coloring layer 15r of R (red) was set to 1.2 micrometers.

[0077] Then, it introduced into the 2nd ink jet equipment 32, and green ink was breathed out from the ink jet head (illustration abbreviation) to the field (field surrounded by the partition 14) in which the pixel which consists of 15g of coloring layers of G (green) is formed. The thing of the viscosity 6 - 8 mPa-s which the organic pigment was changed into the green thing in the presentation of the red ink used above as green ink, and also were used as the same component was used. The contact angle over the nozzle plate of this green ink was 40.5 degrees, and surface tension was 31.4 mN/m. Then, it conveyed to the 2nd dryer 42, ink was dried here, and 15g of coloring layers of G (green) was formed. Desiccation was performed like coloring layer 15r of said R (red). The height (thickness after desiccation) of 15g of coloring layers of G (green) was set to 1.0 micrometers.

[0078] Then, it introduced into the 3rd ink jet equipment 33, and blue ink was breathed out from the ink jet head (illustration abbreviation) to the field (field surrounded by the partition 14) in which the pixel which consists of coloring layer 15b of B (blue) is formed. The thing of the viscosity 6 - 8 mPa-s which the organic pigment was changed into the blue thing in the presentation of the red ink used above as blue ink, and also were considered as the same presentation was used. The contact angle over the nozzle plate of this blue ink was 39.8 degrees, and surface tension was 30.9 mN/m. And it conveyed to the 3rd dryer 43, ink was dried here, and coloring layer 15b of B (blue) was formed. Desiccation was performed like coloring layer 15r of said R (red). The height (thickness after desiccation) of coloring layer 15b of B (blue) was set to 0.8 micrometers. Then, it conveyed in oven 46, postbake was performed the condition for 220 degrees C and 30 minutes, and the coloring layers 15r, 15g, and 15b were stiffened.

[0079] Then, after performing AP processing (atmospheric-pressure plasma treatment) to the substrate base material 11 with which the coloring layers 15r, 15g, and 15b were formed and forming the front face of bank 13 into parent ink, it introduced into the 4th ink jet equipment 34, and the coating liquid L for protective coats was applied to the whole field in which the coloring layers 15r, 15g, and 15b of the substrate base material 11 are formed. As coating liquid L for protective coats, acrylic resin, an epoxy resin, a coupling agent, diethylene-glycol wood ether (solvent of 162 degrees C of boiling points), and the thermosetting resin constituent that consists of butyl carbitol acetate (solvent of 247 degrees C of boiling points) were used. The contact angle [as opposed to 6 mPa-s and a nozzle plate in the viscosity of this coating liquid L for protective coats] was 50 degrees, and

surface tension was 28 mN/m.
[0080] The 4th ink jet equipment 34 was constituted so that the maximum of the width of face which can be applied by carrying out 1 ******** of the ink jet head groups 1 might be set to 152mm. And on the substrate stage 4, the substrate base material 11 was set so that the lengthwise direction of the substrate base material 11 might turn into a travelling direction S, and spreading was started from the corner of the substrate base material 11. At the time of spreading, the edge of the paint film formed with one scan controlled the width of face of a paint film to be located outside the service area of the color filter on the substrate base material 11 by setting up suitably the combination of the nozzle 67 which makes coincidence breathe out coating liquid L among two or more nozzles 67. The spreading width of face of 1 scan eye applied from the end of the lengthwise direction of the substrate base material 11 to the other end as 126mm, subsequently to the longitudinal direction of the substrate base material 11 started a new line, and, specifically, performed 2 scan eye. Line feed width of face was set up so that neither a lap nor a clearance might be made between that of the paint film formed by 1 scan eye, and the paint film formed by 2 scan eye, and spreading width of face of 2 scan eye was set to 126mm. 3 scan eye was applied similarly and the coating liquid L for protective coats was applied on the whole surface of the substrate base material 11.
[0081] Then, it conveyed to the 4th dryer 44 and predrying of the coating liquid L for protective coats applied on the substrate base material 11 was carried out by hot plate desiccation. The heating conditions at the time of desiccation were set as for 5 minutes at 100 degrees C. Furthermore, it introduced into hardening equipment 45, and it heat-treated the condition for [200 degrees-C] 30 minutes, the paint film was stiffened completely, the protective coat 16 was formed, and the color filter 10 was obtained. The surface level difference was measured about the obtained color filter 10. Measurement measured the surface level difference about 20 on one color filter, and calculated the average of 20 places. Consequently, the surface level difference of a protective coat 16 was about 0.29 micrometers. Moreover, the TFT mold liquid crystal equipment of the transparency mold which has the configuration shown in drawing 11 was manufactured using the obtained color filter 10. When the obtained liquid crystal equipment was made to drive, the interference nonuniformity in the edge section of a display screen was not accepted, but the good display was obtained.
[0082] (Example 1 of a comparison) In the above-mentioned example 1, a protective coat 16 was not formed all over the substrate base material 11, but it formed only in the service area of a color filter 10, and also the color filter was manufactured similarly. That is, the black matrix 12, bank 13, and the coloring layers 15r, 15g, and 15b were formed on the substrate book material 11 like the above-mentioned example 1. Then, after performing AP processing and forming the front face of bank 13 into parent ink, the coating liquid L for protective coats was applied only to the field which turns into a service area of a color filter 10 on the substrate base material 11 by the ink jet method. The coating liquid L for protective coats used the same thing as the above-mentioned example 1. Then, like the above-mentioned example 1, after performing predrying and heat curing of a paint film, the substrate base material 11 was cut and the color filter was obtained.
[0083] About the obtained color filter 10, the surface level difference was measured like the above-mentioned example 1. Consequently, although the surface level difference of a protective coat 16 was about 0.30 micrometers, when were used for the TFT mold liquid crystal equipment of a transparency mold like the above-mentioned example 1, and making liquid crystal equipment drive, the interference fringe by which thickness nonuniformity is considered to be the cause by the periphery section (edge section) of a display screen was observed.
[0084]
[Effect of the Invention] Since the part which this climax produced can be cut off in case a substrate base material is cut for each color filter of every even if climax arises in the edge section of a paint film, in case the coating liquid for protective coats applied by the ink jet method on the substrate base material is dried according to this invention, as explained above, the color filter excellent in the surface surface smoothness of a protective coat can be manufactured. Moreover, since there are few amounts of the coating liquid for protective coats to be used and they end compared with the approach of forming a protective coat using the conventional spin coat method, reduction of material costs and low cost-ization can be attained. Moreover, since the surface level difference of a protective coat is 1 micrometer or less, the color filter of this invention has good surface surface

smoothness, and by constituting liquid crystal equipment using this color filter, the gap nonuniformity of the liquid crystal layer prepared in the upper layer of a color filter is prevented, a poor display, such as brightness nonuniformity, is suppressed, and it can obtain a good liquid crystal display. Therefore, according to this invention, liquid crystal equipment and electronic equipment excellent in the homogeneity of the display screen are obtained.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to a color filter, its manufacture approach, liquid crystal equipment, and electronic equipment.

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PRIOR ART

[Description of the Prior Art] In recent years, in electronic equipment, such as a notebook computer, a portable telephone, and an electronic notebook, liquid crystal equipment is widely used as a means to display information. Recently, the electrochromatic display equipment which has arranged the color filter to one substrate and enabled the full color display among the substrates of the pair which counters on both sides of a liquid crystal layer is in use. As shown in drawing 14 , the coloring layers 502r, 502g, and 502b of R (red), G (green), and B (blue) are formed on the front face of the transparence substrate 501 formed by glass, plastics, etc., and, as for the color filter, the protective coat 503 is formed if needed on it. The coloring layers 502r, 502g, and 502b of three colors constitute a pixel, respectively, and these are put in order in the array of a stripe array, a delta array, or a mosaic array. Moreover, between pixels, the black matrix 504 which consists of a protection-from-light layer is established. Furthermore, the transparent electrode layer 505 which consists of ITO film etc. is formed on a protective coat 503. A protective coat 503 is formed for the purpose, such as preventing the heat deterioration of the coloring layers 502r, 502g, and 502b in the process which forms the transparent electrode layer 505 which buries the surface level difference in the condition that the coloring layers 502r, 502g, and 502b were formed, and is made flat.
[0003] In order to manufacture the color filter of such a configuration, on the transparence substrate 501, a FOTORISO graphic method is used, and the black matrix 504 and after forming the coloring layers 502r, 502g, and 502b of R (red), G (green), and B (blue) subsequently, a protective coat 503 is formed first at the upper layer of the coloring layers 502r, 502g, and 502b of these three colors.
[0004] As the formation approach of a protective coat 503, there having been the approach of carrying out heat hardening and forming a protective coat 503, after applying coating liquid with a spin coat method, but this approach's having had much futility of coating liquid, and having un-arranged [to which a production cost becomes high], since the supplied coating liquid dispersed, although excelled in the point which makes the front face of a protective coat 503 flat. Moreover, in order to rotate a substrate at the time of spreading, there was an inclination for coating liquid to flow outside from the inside according to a centrifugal force, and for the thickness of a periphery field to become thick, consequently there was un-arranging [that dispersion in the thickness of a protective coat 503 became large]. The technique using the so-called ink jet is proposed in recent years for these cures.
[0005] For example, the approach of forming in JP,9-329707,A the protective coat 503 by which patterning was carried out by the ink jet method is indicated. This approach is the approach of heat-treating and stiffening by the ink jet method, after applying and carrying out predrying of the coating liquid for protective coat formation only on the service area of a color filter, as shown in drawing 14 .

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EFFECT OF THE INVENTION

[Effect of the Invention] Since the part which this climax produced can be cut off in case a substrate base material is cut for each color filter of every even if climax arises in the edge section of a paint film, in case the coating liquid for protective coats applied by the ink jet method on the substrate base material is dried according to this invention, as explained above, the color filter excellent in the surface surface smoothness of a protective coat can be manufactured. Moreover, since there are few amounts of the coating liquid for protective coats to be used and they end compared with the approach of forming a protective coat using the conventional spin coat method, reduction of material costs and low cost-ization can be attained. Moreover, since the surface level difference of a protective coat is 1 micrometer or less, the color filter of this invention has good surface surface smoothness, and by constituting liquid crystal equipment using this color filter, the gap nonuniformity of the liquid crystal layer prepared in the upper layer of a color filter is prevented, a poor display, such as brightness nonuniformity, is suppressed, and it can obtain a good liquid crystal display. Therefore, according to this invention, liquid crystal equipment and electronic equipment excellent in the homogeneity of the display screen are obtained.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, by this approach, in order that edge section 513a of the paint film 513 applied on the service area of a color filter might become thicker than other parts and might rise so that it may illustrate to drawing 15 when predrying is performed, there was a problem that the front face of the protective coat 503 after hardening did not become flat. Thus, when the level difference had arisen on the front face of the protective coat 503 of a color filter and liquid crystal equipment was constituted using this color filter, there was a problem that gap nonuniformity will arise in the liquid crystal layer prepared in the protective coat 503 side of a color filter, and the brightness nonuniformity in the display screen will arise by it.
[0007] Therefore, the technical problem of this invention is to offer [offering the color filter excellent in the surface smoothness on the front face of a protective coat, and] the approach that the color filter excellent in the surface smoothness on the front face of a protective coat can be manufactured by low cost. Moreover, let it be a technical problem to offer the liquid crystal equipment and electronic equipment using a color filter of this invention.

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MEANS

[Means for Solving the Problem] This invention is what solves at least one of said the technical problems. The manufacture approach of the color filter of this invention The coloring layer formation process which is the manufacture approach of a color filter of the coloring layer being formed on the substrate and coming to form a protective coat on this coloring layer, and forms a coloring layer on a substrate base material, The spreading process which applies the coating liquid for protective coats by the ink jet method on the whole surface of the field in which said coloring layer of said substrate base material is formed, It is characterized by having the hardening process which is made to harden the coating liquid for protective coats applied on said substrate base material, and forms a protective coat, and the cutting process which cuts said substrate base material with which said protective coat was formed for each color filter of every.
[0009] Since the coating liquid for protective coats is applied on the whole surface of a substrate base material according to the manufacture approach of this color filter, the edge section of a paint film turns into the periphery section of a substrate base material. Therefore, even if climax arises in the edge section of a paint film at the process which stiffens the coating liquid for protective coats, the periphery section of a substrate base material becomes thicker than the part of the inner direction. Therefore, if it designs so that the service area of each color filter may not be included in the periphery section of the substrate base material with which a paint film becomes thick on a substrate base material, the front face of a protective coat can be evenly formed in the service area of a color filter at least.
[0010] moreover , in said spreading process , the manufacture approach of the color filter of this invention be characterize by control the width of face of said paint film so that the edge of the cross direction of the paint film form with one scan may be locate outside the service area of a color filter , while it be make to move relatively and it scan the location of said ink jet head and said substrate base material , breathe out said coating liquid for protective coats from two or more nozzles prepare in the ink jet head .
[0011] In the spreading method using the usual ink jet, the field applied with the coating liquid breathed out by coincidence from the ink jet head equipped with two or more nozzles which carry out the regurgitation of the coating liquid is smaller than the spreading field of the whole which is finally going to form the paint film. Therefore, since the whole spreading field is applied moving an ink jet head (scan), on the boundary (line feed section) of a scan and a scan, a paint film tends to become an ununiformity. While making it move relatively and scanning the location of an ink jet head and a substrate base material, breathing out the coating liquid for protective coats from two or more nozzles prepared in the ink jet head according to the approach of this invention Since the width of face of said paint film is controlled so that the edge of the cross direction of the paint film formed with one scan is located outside the service area of a color filter, the boundary (line feed section) of a scan and a scan is formed outside the service area of a color filter, and a uniform paint film is formed in a service area. Here, the cross direction of a paint film is a perpendicular direction to the direction where an ink jet head advances relatively at the time of a scan.
[0012] As for control of the width of face to which the coating liquid for protective coats is applied, in this invention, it is desirable in said spreading process to carry out by changing the combination of the nozzle with which the coating liquid for protective coats is breathed out by coincidence among two or more nozzles prepared in said ink jet head. According to this approach, the width of face of

the paint film at the time of applying the coating liquid for protective coats by the ink jet method can be controlled easily and with high precision, and it can respond also to design changes, such as a substrate base material, easily.

[0013] Moreover, this invention can also change the coverage of the coating liquid for protective coats by the spreading field in said spreading process. In this invention, since an ink jet is used for formation of a protective coat, it is possible to change coverage according to the irregularity of the field which is going to form the protective coat, and the surface smoothness on the front face of a protective coat can be raised more by this.

[0014] Moreover, said coloring layer formation process has the process which applies the coating liquid for coloring layers by the ink jet method, and the process which stiffens this coating liquid for coloring layers, and can consider the manufacture approach of the color filter of this invention as the configuration which performs this coloring layer formation process and the spreading process which applies said coating liquid for protective coats within one production line. Since this approach uses an ink jet also for formation of a coloring layer and forms the protective coat using an ink jet within one production line succeeding this, when working efficiency can be raised, productivity can be raised and fertilization is realized, it is desirable.

[0015] The color filter of this invention is a color filter with which a coloring layer is formed on a substrate and it comes to form a protective coat on this coloring layer, and said protective coat is formed by the ink jet method, and it is characterized by the surface level difference of this protective coat being 1 micrometer or less.

[0016] In this invention, the surface level difference can be held down to 1 micrometer or less by forming the protective coat of a color filter by the ink jet method. If the surface level difference of the protective coat of a color filter is 1 micrometer or less, the homogeneity of the gap of a liquid crystal layer prepared in the protective coat side of a color filter will become good [the surface smoothness on the front face of a protective coat is good, and], when liquid crystal equipment is constituted using this color filter. A poor display, such as brightness nonuniformity which originates in the gap nonuniformity of a liquid crystal layer by this, is suppressed, and a good display is obtained.

[0017] After, as for the color filter of this invention, said protective coat forms a coloring layer on the substrate base material for cutting down a substrate, The coating liquid for protective coats is applied by the ink jet method on the whole surface of the field in which said coloring layer of this substrate base material is formed. After stiffening this coating liquid for protective coats, what was formed by cutting said substrate base material for each color filter of every is desirable. The manufactured color filter using this approach has the description that said protective coat is formed on the whole surface of the substrate of a color filter.

[0018] In case the color filter of this invention cuts a substrate base material since it is cut and obtained for each color filter of every after forming a protective coat on the whole surface of a substrate base material, it can cut off the climax produced in the edge section of a paint film at the time of protective coat formation. Therefore, the protective coat on the substrate of each color filter becomes the thing excellent in surface surface smoothness.

[0019] As for the color filter of this invention, what was performed by making it move relatively and scanning the location of said ink jet head and said substrate base material, spreading of said coating liquid for protective coats breathing out the coating liquid for protective coats from two or more nozzles prepared in the ink jet head is desirable, and if the approach of starting is used, the color filter with which the edge of the cross direction of the paint film applied with one scan exists outside the service area of a color filter will be obtained. If it is in the color filter of this configuration, since the ununiformity part of the paint film by line feed of an ink jet is not formed in the service area of a color filter, it becomes the thing equipped with the homogeneous protective coat excellent in surface surface smoothness.

[0020] It is characterized by the liquid crystal equipment of this invention coming to have the liquid crystal constituent pinched between the color filter of this invention, the opposite substrate by which opposite arrangement was carried out at the side in which the protective coat of this color filter is formed, and said color filter and said opposite substrate. Moreover, the electronic equipment of this invention is characterized by coming to provide the liquid crystal equipment of this invention.

[0021] Since the layer which turns into the upper layer of a protective coat from a liquid crystal constituent is prepared using the color filter excellent in the surface surface smoothness of a protective coat according to the liquid crystal equipment of this invention, it excels in the homogeneity of the gap of a liquid crystal layer. Therefore, a poor display, such as brightness nonuniformity resulting from gap nonuniformity, is suppressed, and a good display is obtained. Moreover, since the liquid crystal equipment which was equipped with the color filter excellent in the surface surface smoothness of a protective coat, and was excellent in the homogeneity of the gap of a liquid crystal layer is used according to the electronic equipment of this invention, a poor display, such as brightness nonuniformity, is prevented and a good liquid crystal display is obtained.
[0022]
[Embodiment of the Invention] Hereafter, the 1st operation gestalt concerning this invention is explained, referring to drawing 7 from drawing 1 . Drawing 1 is the fragmentary sectional view showing the color filter of this operation gestalt. This color filter 10 is equipped with the pixel allotted in the shape of a matrix on substrate 11a, and the boundary line of a pixel and a pixel is divided by the partition 14 which consists of a black matrix 12 which consists of a protection-from-light layer, and bank 13 formed on it. The coloring layers 15r, 15g, and 15b which consist of one ink of R (red), G (green), and B (blue) are formed in the pixel of each, and the protective coat 16 is formed so that these whole may be covered. The so-called mosaic array may be used for the array of R, G, and B, and it may also be other arrays, such as a stripe array and a delta array.
[0023] Drawing 2 is the outline block diagram showing the example of the production line used suitable to manufacture the color filter 10 of this operation gestalt. The production line of this example is equipped with the coloring stratification equipment 51 for performing the process which forms the coloring layers 15r, 15g, and 15b by the ink jet method, and the protective coat formation equipment 52 for performing the process which forms a protective coat 16 by the ink jet method, and the conveyance means is established among these equipments. coloring stratification equipment 51 -- the 1- it has the 3rd ink jet equipment 31, 32, and 33, and the 1st prepared in the latter part of each ink jet equipments 31, 32, and 33 - the 3rd dryer 41, 42, and 43, and the oven 46 for carrying out postbake of the ink is formed in the latter part of the 3rd dryer 43. Moreover, the conveyance means is established between each equipment. The 4th ink jet equipment 34, 4th dryer 44, and hardening equipment 45 are formed in order, and, as for protective coat formation equipment 52, the conveyance means is established between each equipment.
[0024] The approach of forming the coloring layers 15r, 15g, and 15b of a color filter 10 by the ink jet method is well-known (for example, JP,4-123007,A), and coloring stratification equipment 51 can be constituted, using suitably known ink jet equipment and a known dryer.
[0025] The top view in which drawing 3 thru/or drawing 6 show the example of the 4th ink jet equipment 34, drawing 3 shows the outline block diagram of ink jet equipment 34, and drawing 4 shows the array of the ink jet head 72, drawing 5 , and drawing 6 are the explanatory views of an ink jet 72. This 4th ink jet equipment 34 is equipped with the control section C which controls the movable migration device 3, and the ink jet device 2 and the migration device 3 for the location of the ink jet head group 1 equipped with two or more ink jet heads 72 which carry out the regurgitation of the coating liquid L for protective coats to the substrate base material 11 top, the ink jet device 2, and the ink jet head group 1 and the substrate base material 11 relatively.
[0026] The above-mentioned migration device 3 consists of a head supporter 5 which makes it move it to the location of arbitration to the substrate base material 11 while supporting the ink jet head group 1 above the substrate base material 11 laid on the substrate stage 4 so that the nozzle 67 of the ink jet head 72 may turn to a lower part, and a stage mechanical component 6 to which the substrate base material 11 is moved with the substrate stage 4 to the upper ink jet head group 1.
[0027] The above-mentioned head supporter 5 made the horizontal direction (X-axis) and the perpendicular direction (Z-axis) rotate the ink jet head group 1 for the ink jet head group 1 with the passing speed of arbitration the device of the linear motor in which ********** in movable is possible, and focusing on a perpendicular medial axis, and is equipped with the device of the stepping motor which can be set as arbitrary include angles to the downward substrate base material 11.
[0028] The above-mentioned stage mechanical component 6 rotated the substrate stage 4 focusing on

the perpendicular medial axis, and is equipped with theta shaft stage 7 which can be set as arbitrary include angles, and the Y-axis stage 8 in which ********** in movable is possible to horizontally (Y-axis) the substrate stage 4 is intersected perpendicularly in the direction of horizontal migration of the ink jet head group 1 to the upper ink jet head group 1. In addition, theta shaft stage 7 consists of stepping motors etc., and the Y-axis stage 8 consists of linear motors etc.

[0029] The above-mentioned ink jet device 2 is equipped with tank 9b which stores the coating liquid L for protective coats, in order to connect with the ink jet head group 1 through tube 9a and to supply the coating liquid L for protective coats to the ink jet head 72 of this ink jet head group 1. That is, spreading is performed by filling up the ink jet head 72 of the ink jet head group 1 with the coating liquid L for protective coats through tube 9a from tank 9b. It has the regurgitation device in which compress a liquid room and a liquid is made to breathe out by the pressure wave by the piezo-electric element, and the above-mentioned ink jet head 72 has two or more nozzles 67 arranged by a single tier or two or more trains.

[0030] Drawing 4 is what showed the example of the array of the nozzle 67 in the ink jet head group 1, and is drawing which carried out plane view of the inferior surface of tongue (field which counters the substrate stage 4) of the ink jet head group 1. In this example, 12 ink jet heads 72 equipped with the nozzle 67 and the regurgitation device 71 of a predetermined number (six piece x2 train) are formed in the ink jet head group 1. If the ink jet head group 1 sets to S the direction which advances relatively to the substrate base material 11 on the substrate stage 4 and makes a direction perpendicular to this direction the cross direction W It is parallel to a travelling direction S so that 12 ink jet heads 72 may make a train along the one direction where a nozzle 67 has the include angle of arbitration to a travelling direction S, and it is arranged so that the straight line which passes along each nozzle 67 may serve as regular intervals in the cross direction W. Although the number of the nozzles 67 prepared in one ink jet head 72 and the number of the ink jet heads 72 can be changed suitably, it is set up so that the width of face (magnitude in the cross direction W) which can be applied to coincidence by the coating liquid breathed out from two or more nozzles 67 prepared in the ink jet head group 1 may become larger than the magnitude of the service area of one color filter 10.

[0031] The structure of each ink jet head 72 is equipped with the nozzle plate 61 and diaphragm 62 made from stainless steel as shown in drawing 5 and drawing 6 , and both are joined through the batch member (reservoir plate) 63. Between the nozzle plate 61 and the diaphragm 62, two or more space 64 and liquid reservoirs 65 are formed of the batch member 63. The interior of each space 64 and a liquid reservoir 65 is filled with the coating liquid L for protective coats, and each space 64 and a liquid reservoir 65 are opening it for free passage through a feed hopper 66. Furthermore, the nozzle 67 which serves as a hole for injecting the coating liquid L for protective coats from space 64 is formed in the nozzle plate 61. On the other hand, the hole 68 for supplying the coating liquid L for protective coats to a liquid reservoir 65 is formed in the diaphragm 62.

[0032] Moreover, on the field which counters the space 64 of a diaphragm 62, and the field of the opposite side, the piezoelectric device (piezo-electric element) 69 is joined. This piezoelectric device 69 is located between the electrodes 70 of a pair, and if it energizes, it will bend so that a piezoelectric device 69 may project outside, and the diaphragm 62 with which the piezoelectric device 69 is joined to coincidence will also be united, and it will bend outside. The volume of space 64 increases by this. Therefore, the coating liquid L for protective coats equivalent to a part for the volume which increased in space 64 flows through a feed hopper 66 from a liquid reservoir 65. Next, if the energization to a piezoelectric device 69 is canceled, both a piezoelectric device 69 and the diaphragm 62 will return to the original configuration. Thereby, since space 64 also returns to the original volume, the pressure of the coating liquid L for protective coats of the space 64 interior rises, and the drop 60 of the coating liquid L for protective coats is breathed out towards the substrate base material 11 from a nozzle 67. In addition, methods other than the piezo jet type using the above-mentioned piezoelectric device as an ink jet method of the ink jet head 72 may be used, for example, it does not matter even if it adopts methods, such as an ink blowing pressure force jet method (for example, bubble jet (trademark) method) using the electric thermal-conversion object as an energy generation component.

[0033] The above-mentioned control section C is a computer which has the I/O function of CPUs,

such as a microprocessor which controls the whole equipment, or various signals, and it connects with the ink-jet device 2 and the migration device 3 electrically, respectively, and it has the function control either [at least] discharging by the ink jet device 2, or the migration actuation by the migration device 3, and change the spreading conditions of the coating liquid L for protective coats.
[0034] In this operation gestalt, the control section C is equipped with the function to change the combination of the nozzle 67 with which the coating liquid L for protective coats is breathed out by coincidence among two or more nozzles 67, in each ink jet head 72. Thereby, the regurgitation location of the coating liquid L in the ink jet head 72 can be changed, and when moving the ink jet head group 1 to a travelling direction S once, the width of face by which the coating liquid L for protective coats is applied on (1 Scan) and the substrate base material 11 can be controlled. Moreover, it is parallel to the travelling direction S of the ink jet head group 1, and if it controls so that the number of nozzles 67 with which the coating liquid L for protective coats is breathed out by coincidence on the straight line about all of the straight lines which pass along a nozzle 67 becomes equal, it is desirable when making coverage into homogeneity.
[0035] Furthermore, it is desirable to have the function in which a control section C can control coverage by the field where the coating liquid L for protective coats is applied. For example, it is desirable to prepare the control function which is repeated in case it applies to the same location on the control function which changes the discharge quantity from each nozzle 67 according to an individual, and/or the substrate base material 11 repeatedly and which sets up spreading conditions for every spreading, and to suppose that it is controllable so that the part where thickness differs may exist also in the paint film applied with one scan. Coverage is changed according to the shape of toothing of the front face of the substrate base material 11 just before applying this configuration, then the coating liquid L for protective coats, and it becomes possible to make still smaller the surface level difference D of a protective coat 16.
[0036] Drawing 7 (a) - (e) is the type section Fig. having shown how to manufacture the color filter 10 of this operation gestalt, in order of the process. First, the substrate base material 11 of the magnitude which can start two or more substrate 11a of one color filter 10 is prepared, and as shown in drawing 7 (a), the black matrix 12 is formed on the substrate base material 11. Although a glass substrate is generally used, if it has properties needed in the application as a color filter, such as transparency and a mechanical strength, as a substrate base material 11, ingredients other than glass can also be used.
[0037] The black matrix 12 is formed with the layered product of a chromium metal, a chromium metal, and chromic oxide, or resin black. In order to form the black matrix 12 which consists of a metal thin film, a spatter and vacuum deposition can be used. Moreover, in order to form the black matrix 12 which consists of a resin thin film, gravure, the photoresist method, a hot printing method, etc. can be used.
[0038] Then, bank 13 is formed on the black matrix 12. That is, as shown in drawing 7 (b), where the mask film 18 which formed the resist layer 17 which consists of a transparent photopolymer constituent of a negative mold, and was formed in the top face at the matrix pattern configuration is stuck, exposure processing is performed so that the substrate base material 11 and the black matrix 12 may be covered. And as shown in drawing 7 (c), by carrying out etching processing of the part for the unexposed part of the resist layer 17, patterning of the resist layer 17 is carried out, and bank 13 is formed. In a next process, in case this bank 13 and the black matrix 12 under it form the coloring layers 15r, 15g, and 15b by the ink jet method, they serve as the partition 14 which plays the role of the bank which regulates the breadth of ink.
[0039] Since the impact location precision of ink at the time of forming the coloring layers 15r, 15g, and 15b at a next process on the substrate base material 11 surrounded by the ink jet method on the bank 13 since a glass substrate (substrate base material 11) front face is parent ink nature when the resin ingredient with which a paint film front face serves as non-dense ink nature is used as an ingredient which forms bank 13 improves, it is desirable. In addition, in this case, after the coloring layers 15r and 15g and 15b formation, before forming a protective coat 16, it is desirable to form the top face of bank 13 into parent ink, and it is desirable to form the equipment for it between coloring stratification equipment 51 and protective coat formation equipment 52.
[0040] Next, as shown in drawing 7 (d), the coating liquid for coloring layers (ink) is applied to the

inside of the field surrounded by the partition 14, i.e., a pixel, this is dried, and the coloring layers 15r, 15g, and 15b are formed. this operation gestalt -- the 1- the coloring layers 15r, 15g, and 15b of three colors are formed in order using coloring stratification equipment 51 equipped with the 3rd ink jet equipment 31, 32, and 33. The formation sequence of the coloring layers 15r, 15g, and 15b of three colors is not limited.

[0041] For example, the substrate base material 11 with which the partition 14 was formed is first introduced into the 1st ink jet equipment 31, and the regurgitation of the red ink is carried out from an ink jet head (illustration abbreviation) only to the field in which the pixel which consists of coloring layer 15r of R (red) among many pixels is formed. Then, it conveys to the 1st dryer 41, ink is dried here, and coloring layer 15r of R (red) is formed. Then, the substrate base material 11 with which coloring layer 15r of R (red) was formed is conveyed to the 2nd ink jet equipment 32, and the regurgitation of the green ink is carried out from an ink jet head (illustration abbreviation) only to the field in which the pixel which consists of 15g of coloring layers of G (green) among many pixels is formed. And it conveys to the 2nd dryer 42, ink is dried here, and 15g of coloring layers of G (green) is formed. Then, the substrate base material 11 with which 15g of coloring layers of coloring layer 15r and G (green) of R (red) was formed is conveyed to the 3rd ink jet equipment 33, and the regurgitation of the blue ink is carried out from an ink jet head (illustration abbreviation) only to the field in which the pixel which consists of coloring layer 15b of B (blue) among many pixels is formed. Then, it conveys to the 3rd dryer 43, ink is dried here, and coloring layer 15b of B (blue) is formed. in addition, the 1- in case the black matrix 12 is formed so that the substrate base material 11 can be positioned in the 3rd ink jet equipment 31 and 32 and 33 at a precision for example, it is desirable to form the mark for alignment.

[0042] Viscosity is 2 - 20 mPa-s, the ink which forms the coloring layers 15r, 15g, and 15b has a contact angle larger than 50 degrees over a nozzle plate, and that [its] whose surface tension is 20 - 40 mN/m is desirable. There is a possibility of supply of the next ink after ink breathes out not meeting the deadline, and starting the poor regurgitation if the viscosity of ink is too high, and when viscosity is too low, there is a possibility that a fluidity may be too good and may serve as fault supply of ink. Moreover, if the contact angle over the nozzle plate of ink is too low, in case a nozzle plate will get wet in ink and an ink droplet will be breathed out, an ink droplet can draw near to the ink adhering to a nozzle plate, and there is a possibility that it may not be breathed out in an exact location. Moreover, even if too small [the surface tension of ink is too large, and], the stable meniscus control by vibration of a piezoelectric device becomes impossible. For example, an acrylic resin color paste, an aquosity melamine color paste, etc. can be used.

[0043] Although a difference has the thickness of the coloring layers 15r, 15g, and 15b by each class of RGB, it considers as within the limits of 0.8-1.2 micrometers in general. It is a 30-80-degree C temperature requirement, as for the process which dries ink, it is desirable to carry out the condition for 3 - 5 minutes, and it is desirable to set up the 3rd configuration of the 1st - dryers 41, 42, and 43, conveyance conditions, etc. so that these conditions may be suited. Moreover, after forming the coloring layers 15r, 15g, and 15b of three colors, oven 46 performs postbake (this baking) and ink is stiffened. The heating conditions at this time are preferably set as 220 degrees C and a 30-minute about room.

[0044] Then, as shown in drawing 7 (e), a protective coat 16 is formed so that the top face of the substrate base material 11, partition 14, and the coloring layers 15r, 15g, and 15b may be covered. Namely, the substrate base material 11 with which the coloring layers 15r, 15g, and 15b were formed It is conveyed to protective coat formation equipment 52. With the 4th ink jet equipment 34 Coloring layer 15r of the substrate base material 11, After the coating liquid L for protective coats is applied to the whole field in which 15g and 15b are formed and predrying is carried out with the 4th dryer 44, this coating liquid L is hardened with hardening equipment 45, and a protective coat 16 is formed.

[0045] Like the ink which fulfills the property required of the application as a protective coat as coating liquid L for protective coats, and forms the coloring layers 15r, 15g, and 15b by the ink jet although it is usable if spreading is possible, viscosity is 2-20mPa, the contact angle over a nozzle plate is more preferably larger than 50 degrees 35 degrees or more, and that whose surface tension is 20 - 40 mN/m is desirable. Moreover, in case an ingredient is selected, what has the good leveling

nature to which the front face after spreading becomes flat promptly, and what has the good wettability to a spreading side are desirable, and, as for especially a solvent, what has the next good drying method and the compatibility in a desiccation process is desirable. Moreover, an additive uses what does not degrade the property of a protective coat. Although it can be changed by changing combination of a solvent, when the cure rate of the coating liquid L for protective coats has a too quick cure rate, before flattening of the applied paint film is carried out, it is hardened, and has a possibility that the surface smoothness of protective coat 16 front face may worsen. On the contrary, if a cure rate is too slow, since the drying time will start for a long time, productivity worsens.

[0046] As this coating liquid L for protective coats, it consists of 10 - 20 % of the weight of acrylic resin, 0.1 - 3 % of the weight of epoxy resins, 0.1 - 3 % of the weight of coupling agents, 35 - 60 % of the weight (solvent of 162 degrees C of boiling points) of diethylene-glycol wood ether, and 20 - 45 % of the weight (solvent of 247 degrees C of boiling points) of butyl carbitol acetate, and the thermosetting resin constituent which is 46-52 degrees of contact angles, the surface tension 25 - 29 mN/m to viscosity 4 - 8 mPa-s, and a nozzle plate can be used preferably, for example.

[0047] The effectiveness which will bury the level difference of partition 14 and the coloring layers 15r, 15g, and 15b, and will carry out flattening of the front face if the thickness of the protective coat 16 after desiccation is too thin is not fully acquired, but if too thick, starting productivity will become [the drying time] long bad. In this operation gestalt, generally the level difference of the partition 14 and the coloring layers 15r, 15g, and 15b just before forming a protective coat 16 is about 1.5-1.8 micrometers, and, as for the thickness of a protective coat 16 which buries this, it is desirable to be referred to as about 3.0-4.0 micrometers after hardening.

[0048] In order to apply the coating liquid L for protective coats with the 4th ink jet equipment 34, the ink jet head group 1 and/or the substrate stage 4 are moved so that the substrate base material 11 may be set and the ink jet head group 1 may be first located above the spreading starting position of the substrate base material 11 on the substrate stage 4. Subsequently, making the coating liquid L for protective coats breathe out at intervals of the predetermined regurgitation from the ink jet head 72 of the ink jet head group 1, the substrate stage 4 is moved in the direction of Y, and 1 scan eye is applied. In this case, the relative travelling direction S of the ink jet head 72 turns into the direction of Y. And making the coating liquid L for protective coats **** at intervals of the predetermined regurgitation from the ink jet head 72 again, after starting a new line by moving the ink jet head group 1 in the direction of X, the substrate stage 4 is moved in the direction of Y, and 2 scan eye is applied. Thus, the coating liquid L for protective coats is applied all over the substrate base material 11, repeating line feed of a scan. Or making the coating liquid L for protective coats **** from the ink jet head 72 of the ink jet head group 1, the ink jet head group 1 is moved in the direction of X, 1 scan may be applied and the substrate stage 4 may be moved in the direction of Y at the time of line feed. In this case, the relative travelling direction S of the ink jet head 72 turns into the direction of X.

[0049] Width of face of the paint film formed with one scan is made larger than the service area of one color filter 10, and it applies so that the edge of the cross direction of the paint film formed with one scan may be located outside the service area of a color filter. Moreover, it is desirable to control coverage so that desired thickness is obtained. The coverage per unit area is good also as homogeneity on the whole surface of the substrate base material 11, or may change coverage by the part according to the irregularity of the front face of the substrate base material 11 just before applying the coating liquid L for protective coats. For example, since partition 14 differs in height from the coloring layers 15r, 15b, and 15c, if it controls to change the discharge quantity at the time of carrying out the regurgitation of the coating liquid L for protective coats to each top face, the surface smoothness of the front face of a protective coat 16 can be raised more.

[0050] Specifically, thickness is controllable by changing the discharge quantity of the coating liquid L from each nozzle 67 by the control section C. That is, the coverage per unit area changes in proportion to discharge quantity, and if discharge quantity is increased, while being able to thicken thickness, thickness can be made thin if discharge quantity is reduced. Or in case it applies to the same location on the substrate base material 11 repeatedly, the thickness of a paint film can be controlled also by [repeating] controlling the discharge quantity of the coating liquid L from each above-mentioned nozzle 67 for every spreading, respectively.

[0051] Known technique, such as the spin drying method, the hot plate drying method, and a vacuum-drying method, can be suitably used for the process to which predrying of the paint film of the coating liquid for protective coats is carried out with the 4th dryer 44. It is desirable to adopt the proper drying method according to the surface state of the paint film before desiccation not only by the condition of the paint film before desiccation but by the difference in the drying method, taking into consideration a result of protective coat 16 front face, productivity, etc., since the surface surface smoothness of the protective coat 16 after desiccation may change.
[0052] By heat-treating with hardening equipment 45 equipped with heating means, such as oven equipped with the warm air blower style for the substrate base material 11 after predrying, the process which stiffens the paint film after predrying with hardening equipment 45 stiffens a paint film, and let it be a protective coat 16. The conditions at the time of heating are suitably set up according to an ingredient, thickness, etc. of a paint film.
[0053] Thus, after forming a protective coat 16, a color filter 10 is obtained by cutting the substrate base material 11 for each service area of every. Moreover, it is desirable while assembling a liquid crystal panel, after assembling a liquid crystal panel using the substrate base material 11 in using this color filter 10 for liquid crystal equipment to cut the substrate base material 11 for every color filter.
[0054] According to this operation gestalt, the surface level difference D of a protective coat 16 can be made small to 1 micrometer or less. The value of the surface level difference D here means the value of the difference of the upper limit when measuring a front face with a contact process level difference measuring device, and a lower limit. Moreover, since the ink jet method is used for formation of a protective coat 16, compared with the case where a spin coat method is used, there is little amount of the coating liquid used, it ends, and the color filter excellent in surface surface smoothness can be manufactured by low cost.
[0055] In addition, although the ink jet head group 1 which considered as the means which carries out the regurgitation of the coating liquid L in ink jet equipment, and was equipped with two or more ink jet heads 72 was used with this operation gestalt, if the paint film of desired width of face is obtained with one scan, it is also possible to constitute a regurgitation means only from one ink jet head. Like this operation gestalt, if a regurgitation means is constituted using two or more ink jet heads 72, the existing small ink jet head can be used, and it can constitute so that a paint film with comparatively wide width of face may be obtained with one scan.
[0056] Moreover, the array of the ink jet head 72 in the ink jet head group 1 is making the train along the one direction where not only the array of this operation gestalt but the nozzle 67 has the include angle of arbitration to a travelling direction S, and is parallel to a travelling direction S, and can be considered as a proper array that what is necessary is to just be arranged so that the straight line which passes along each nozzle 67 may serve as regular intervals in the cross direction W. For example, two or more [to the cross direction W / head / 72 / ink jet], as shown in drawing 8 , in the example of this drawing, each ink jet head 72 may be arranged with 2 successive-installation **** to three pieces and a travelling direction S so that a nozzle 67 may make a train along the cross direction W. In edge 72a of the cross direction W of the ink jet head 72 of eye one train, it is parallel to a travelling direction S, and in edge 72b of the cross direction W of the straight line which passes along a nozzle 67, and the ink jet head 72 of eye two trains, it is parallel to a travelling direction S, and, as for a part of straight line which passes along a nozzle 67, constituting so that it may lap is desirable. In addition, in this drawing, the regurgitation device of an ink jet head is omitting illustration.
[0057] Drawing 9 is what showed the 1st example which constituted liquid crystal equipment using the color filter 10 of this operation gestalt, and is the sectional view showing the outline configuration of passive matrix type liquid crystal equipment (liquid crystal equipment). The transparency mold liquid crystal display as a final product is obtained by equipping the liquid crystal equipment 100 of this example with incidental elements, such as IC for a liquid crystal drive, a back light, and a base material.
[0058] This liquid crystal equipment 100 is equipped with the color filter 10 explained with the 1st operation gestalt, and arranges a color filter 10 to the up side (watcher side). In addition, suppose that a color filter 10 is explained simple in this operation gestalt. The important section of transparency mold liquid crystal equipment 100 is shown in this drawing, between the opposite substrates 101

which consist of a color filter 10, a glass substrate, etc., the liquid crystal layer 103 which consists of a STN (Super Twisted Nematic) liquid crystal constituent etc. is pinched, and the outline configuration of this liquid crystal equipment 100 is carried out. A color filter 10 is the same as the color filter explained with the 1st operation gestalt, and is equipped with the partition 14 and the coloring layers 15r, 15g, and 15b which consist of substrate 11a, a black matrix 12, and bank 13, and a protective coat 16.

[0059] On the protective coat 16 of a color filter 10 (liquid crystal layer side), two or more 1st electrodes 106 are formed in the shape of a stripe at the predetermined spacing, and the orientation film 109 is formed so that the top face may be covered. On the other hand, on the color filter 10 in the opposite substrate 101, and the field which counters (liquid crystal layer side), two or more 2nd electrodes 105 which extend in the direction which intersects perpendicularly with the 1st electrode 106 by the side of a color filter 10 are formed in the shape of a stripe at the predetermined spacing, and the orientation film 107 is formed so that the top face may be covered. The part where the 1st electrode 106 and 2nd electrode 105 cross is a pixel, and it is constituted so that the coloring layers 15r, 15g, and 15b of a color filter 10 may be located in the part used as this pixel. Moreover, although not illustrated, the polarizing plate is installed in the external surface side of the opposite substrate 101 and a color filter 10, respectively. Moreover, a sign 104 is a spacer for holding uniformly in a substrate side spacing between substrates (it being called a cel gap), and a sign 110 is a sealant for holding a liquid crystal constituent between substrates. In addition, the 1st electrode 106 and 2nd electrode 105 form transparence electrical conducting materials, such as ITO (Indium Tin Oxide), in the shape of a plane view stripe. The end section of the 1st electrode 106 is formed so that it may extend to the outside of a sealant, and it is making leading-about wiring 106a.

[0060] Since according to the liquid crystal equipment 100 of this configuration the protective coat 16 of a color filter 10 cuts and is formed after membranes are formed by the ink jet all over the substrate base material 11, it excels in surface surface smoothness. Therefore, the nonuniformity of the cel gap in liquid crystal equipment 100 is stopped small, the brightness nonuniformity in the display screen is improved and a good display is obtained. Moreover, since the surface surface smoothness of the protective coat 16 of a color filter 10 is good, the surface surface smoothness of the 1st electrode currently formed in the upper layer and the surface surface smoothness of the orientation film 109 will also become good. Therefore, the rubbing nonuniformity which originates in the surface level difference of the orientation film 109, and is produced is prevented, and a good liquid crystal display property is acquired. Since the ink jet was furthermore used for formation of a protective coat 16, compared with the case where a protective coat is formed, there is little amount of the coating liquid used, it ends with a spin coat method, and a manufacturing cost is reduced.

[0061] Drawing 10 is what showed the 2nd example which constituted liquid crystal equipment using the color filter 10 of this operation gestalt, and is the sectional view showing the outline configuration of passive matrix type liquid crystal equipment (liquid crystal equipment). The transparency mold liquid crystal display as a final product is obtained by equipping the liquid crystal equipment 200 of this operation gestalt with incidental elements, such as IC for a liquid crystal drive, a back light, and a base material. The point that this liquid crystal equipment 200 differs from the liquid crystal equipment 100 of said 1st example greatly is a point which has arranged the color filter 10 to the down side (opposite side by the side of a watcher). In addition, in this example, about the component of a color filter 10, the same sign as the 1st example of the above is attached, and the explanation is omitted.

[0062] The important section of transparency mold liquid crystal equipment 200 is shown in this drawing, between the opposite substrates 201 which consist of a color filter 10, a glass substrate, etc., the liquid crystal layer 203 which consists of STN (Super Twisted Nematic) liquid crystal etc. is pinched, and the outline configuration of this liquid crystal equipment 200 is carried out. On the protective coat 16 of a color filter 10 (liquid crystal side), two or more 1st electrodes 206 are formed in the shape of a stripe at the predetermined spacing, and the orientation film 209 is formed so that the top face may be covered. On the other hand, on the color filter 10 of the opposite substrate 201, and the field which counters (liquid crystal layer side), two or more 2nd electrodes 205 which extend in the direction which intersects perpendicularly with the 1st electrode 206 by the side of a color filter are formed in the shape of a stripe at the predetermined spacing, and the orientation film 207 is

formed so that the top face may be covered. And the crossing part of the 1st electrode 206 and the 2nd electrode 205 is a pixel, and it is constituted so that the coloring layers 15r, 15g, and 15b of a color filter 10 may be located in the part used as this pixel.
[0063] Moreover, although not illustrated, the polarizing plate is installed in the external surface side of the opposite substrate 201 and a color filter 10, respectively. Moreover, a sign 204 is a spacer for holding uniformly in a substrate side spacing between substrates (it being called a cel gap), and a sign 210 is a sealant for holding liquid crystal between substrates. In addition, the 1st electrode 206 and 2nd electrode 205 form transparence electrical conducting materials, such as ITO (Indium Tin Oxide), in the shape of a plane view stripe. According to the liquid crystal equipment 200 of this configuration, the same effectiveness as the liquid crystal equipment 100 of said 1st example is acquired, and improvement of the brightness nonuniformity in liquid crystal equipment and rubbing nonuniformity and low cost-ization can be realized.
[0064] Drawing 11 is what showed the 3rd example which constituted liquid crystal equipment using the color filter 10 of this operation gestalt, and is the decomposition perspective view showing the outline configuration of the TFT mold (Thin Film Transistor mold) liquid crystal equipment 300 of a transparency mold. The transparency mold liquid crystal display as a final product is constituted by equipping the liquid crystal equipment 300 of this operation gestalt with incidental elements, such as IC for a liquid crystal drive, a back light, and a base material. This liquid crystal equipment 300 is equipped with the color filter 10 of said 1st operation gestalt, and arranges a color filter 10 to the up side (watcher side). In addition, in this example, about the component of a color filter 10, the same sign as the 1st example of the above is attached, and the explanation is omitted.
[0065] The liquid crystal equipment 300 of this operation gestalt is constituted considering a color filter 10, the opposite substrate 314 arranged so that this may be countered, the liquid crystal layer which was pinched among these and which is not illustrated, the polarizing plate 316 attached to the top-face side (watcher side) of a color filter 10, and the polarizing plate which was attached to the inferior-surface-of-tongue side of the opposite substrate 314 and which is not illustrated as a subject. On the protective coat 16 of a color filter 10, the electrode 318 for a liquid crystal drive is formed. This electrode 318 consists of transparence electrical conducting materials, such as ITO (Indium Tin Oxide), and let it be the whole surface electrode which covers the whole field in which the below-mentioned pixel electrode 332 is formed. Moreover, an electrode 318 is covered and the orientation film 319 is formed in the liquid crystal layer side.
[0066] On the other hand, the insulating layer 325 is formed on the opposite substrate 314, and the switching element and the pixel electrode 332 of a TFT mold are formed on the insulator layer 325. In addition, although the orientation film is prepared on the pixel electrode 332 with actual liquid crystal equipment, it is omitting in this drawing.
[0067] Thin film transistor T (TFT) as a switching element On the insulating layer 325 formed on the opposite substrate 314, signal-line 352 -- is formed with scanning-line 351 -- in the shape of a matrix. The pixel electrode 332 is formed for every field surrounded by signal-line 352 -- with these scanning-lines 351 --. Thin film transistor T possessing a source electrode, a drain electrode, a semi-conductor, and a gate electrode is incorporated and constituted by the part between the corner part of each pixel electrode 332, the scanning line 351, and a signal line 352. And it is constituted so that thin film transistor T may be turned on and off and energization control to the pixel electrode 332 can be performed by impression of a signal to the scanning line 351 and a signal line 352.
[0068] According to the liquid crystal equipment 300 of this configuration, the same effectiveness as the liquid crystal equipment 100 of said 1st example is acquired, and improvement of the brightness nonuniformity in liquid crystal equipment and rubbing nonuniformity and low cost-ization can be realized. Moreover, although the liquid crystal equipment of each above-mentioned example was considered as the configuration of a transparency mold, it can prepare a reflecting layer or a transflective reflection layer in a proper location, and can also constitute the liquid crystal equipment of a reflective mold, or the liquid crystal equipment of a transflective reflective mold.
[0069] Drawing 12 is the fragmentary sectional view having shown the 2nd operation gestalt of a color filter. The point that the color filter 90 of this operation gestalt differs from the color filter 10 of said 1st operation gestalt greatly is a point that the coloring layers 95r, 95g, and 95b are formed by the FOTORISO graphic method not using the ink jet. This color filter 90 is equipped with the pixel

allotted in the shape of a matrix on substrate 91a, and the boundary line of a pixel and a pixel is divided by the black matrix 92 which consists of a protection-from-light layer. The coloring layers 95r, 95g, and 95b which consist of one ink of R (red), G (green), and B (blue) are formed in the pixel of each, and the protective coat 96 is formed so that these whole may be covered. The so-called mosaic array may be used for the array of R, G, and B, and it may also be other arrays, such as a stripe array and a delta array.

[0070] What is necessary is to form a protective coat 96 by the ink jet method, and just to cut the substrate base material 91 for each color filter of every next, after using a FOTORISO graphic method and forming in order the black matrix 92 and the coloring layers 95r, 95g, and 95b which subsequently consist of ink of R (red), G (green), and B (blue) on the substrate base material 91, in order to manufacture the color filter 90 of this operation gestalt. The same procedure as the formation process of the protective coat 16 in said 1st operation gestalt can perform formation of a protective coat 96 using the protective coat formation equipment 52 34 in said 1st operation gestalt, i.e., the 4th ink jet equipment, the 4th dryer 44 and hardening equipment 45, and the same equipment. In this operation gestalt, since an ink jet is used for applying the coating liquid L for protective coats on the substrate base material 91 with which the coloring layers 95r, 95g, and 95b were formed, on the whole surface of the substrate base material 91, it is good also as homogeneity in the coverage per unit area, or it is also possible to change coverage on the coloring layers 95r and 95g and 95b the black matrix 92 top, and to control thickness.

[0071] Also in this operation gestalt, the surface level difference D of a protective coat can be made small like said 1st operation gestalt at 1 micrometer or less. Moreover, since the ink jet is used for formation of a protective coat, compared with the case where a spin coat method is used, there is little amount of the coating liquid used, it ends, and the color filter excellent in surface surface smoothness can be manufactured by low cost. Moreover, the color filter 91 of this operation gestalt as well as the color filter 10 of said 1st operation gestalt can constitute liquid crystal equipment, and the same operation effectiveness can be acquired.

[0072] Next, the operation gestalt of the electronic equipment of this invention is explained. Drawing 13 (a) is the perspective view having shown an example of a cellular phone. A sign 600 shows the body of a cellular phone, and the sign 601 shows the liquid crystal display section. Drawing 13 (b) is the perspective view having shown an example of pocket mold information processors, such as a word processor and a personal computer. An information processor and a sign 701 show the input sections, such as a keyboard, a sign 703 shows the body of an information processor, and, as for the sign 700, the sign 702 shows the liquid crystal display section. Drawing 13 (c) is the perspective view having shown an example of wrist watch mold electronic equipment. A sign 800 shows the body of a clock and the sign 801 shows the liquid crystal display section. In these electronic equipment, the liquid crystal display sections 601, 702, and 801 are constituted using either of liquid crystal equipment 100, 200, and 300 equipped with either of said 1st or 2nd color filter 10 and 90, for example, the liquid crystal equipments of said 1-3rd examples.

[0073] If it is in the electronic equipment of these operation gestalten, since the liquid crystal display sections 601, 702, and 801 are constituted using the liquid crystal equipments 100, 200, and 300 which were equipped with the color filter 10 excellent in the surface surface smoothness of a protective coat, and were excellent in the homogeneity of the gap of a liquid crystal layer, a poor display, such as brightness nonuniformity, is prevented and a good liquid crystal display is obtained.

[Translation done.]

* NOTICES *

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EXAMPLE

[Example] (Example 1) The color filter 10 was manufactured by the approach shown in drawing 7 . First, the substrate base material 11 which consists of 47cm long, 37cm wide, and alkali free glass with a thickness of 0.7mm was prepared, after it washed the front face to heat concentrated sulfuric acid by the penetrant remover which added hydrogen peroxide solution 1% of the weight and it carried out the rinse to it with pure water, air desiccation was performed and the front face was defecated. Next, after thickness formed the chromium thin film which is an average of 0.2 micrometers by the spatter on the front face of the defecated substrate base material 11, it etched into it and the black matrix 12 was formed in it. Arrangement of two or more color filters 10 which can be set on the substrate base material 11 left the margin of the shape of a frame with a width of face of 20mm to the periphery section, and it has arranged it so that 28mm long and a 36mm wide service area may be located in a line with the inside in the shape of a matrix. Moreover, spacing of the service area which adjoins each other in a lengthwise direction was set to 7mm, and spacing of the service area which adjoins each other in a longitudinal direction was set to 6mm.
[0075] Subsequently, the resist layer 17 which consists of a transparence photopolymer constituent of fluorine content acrylic of a negative mold was formed with the spin coat method on the substrate base material 11 with which the black matrix 12 was formed, and after it heated this for 20 minutes and it carried out predrying at 100 degrees C, where the mask film 18 formed in the predetermined matrix pattern configuration is stuck, ultraviolet rays were irradiated and were exposed. And after being immersed in the alkaline developer and removing the resist layer of the part which is not exposed, the rinse by pure water, spin desiccation, and heat curing were performed in order, and the bank 13 was formed. The heating conditions at the time of carrying out heat curing were set as for 30 minutes at 200 degrees C. A front face is non-dense ink nature, and height set the bank 13 to about 2.5 micrometers.
[0076] Next, the substrate base material 11 with which the partition 14 which consists of a black matrix 12 and bank 13 was formed was introduced into the 1st ink jet equipment 31, and red ink was breathed out from the ink jet head (illustration abbreviation) to the field (field surrounded by the partition 14) in which the pixel which consists of coloring layer 15r of R (red) is formed. As red ink, after making polyurethane resin oligomer distribute a red organic pigment, a cyclohexanone and butyl acetate were added as a low boiler, butyl carbitol acetate was added as a high boiler, 0.01 % of the weight of non-ion system surfactants was further added as a dispersant, and what was made into viscosity 6 - 8 mPa-s was used. The contact angle over the nozzle plate of this red ink was 40.1 degrees, and surface tension was 30.8 mN/m. Then, it conveyed to the 1st dryer 41, ink was dried here, and coloring layer 15r of R (red) was formed. Desiccation was performed on 50 degrees C and the heating conditions for 3 minutes using the hot plate. The height (thickness after desiccation) of coloring layer 15r of R (red) was set to 1.2 micrometers.
[0077] Then, it introduced into the 2nd ink jet equipment 32, and green ink was breathed out from the ink jet head (illustration abbreviation) to the field (field surrounded by the partition 14) in which the pixel which consists of 15g of coloring layers of G (green) is formed. The thing of the viscosity 6 - 8 mPa-s which the organic pigment was changed into the green thing in the presentation of the red ink used above as green ink, and also were used as the same component was used. The contact angle over the nozzle plate of this green ink was 40.5 degrees, and surface tension was 31.4 mN/m. Then, it conveyed to the 2nd dryer 42, ink was dried here, and 15g of coloring layers of G (green) was

formed. Desiccation was performed like coloring layer 15r of said R (red). The height (thickness after desiccation) of 15g of coloring layers of G (green) was set to 1.0 micrometers.
[0078] Then, it introduced into the 3rd ink jet equipment 33, and blue ink was breathed out from the ink jet head (illustration abbreviation) to the field (field surrounded by the partition 14) in which the pixel which consists of coloring layer 15b of B (blue) is formed. The thing of the viscosity 6 - 8 mPa-s which the organic pigment was changed into the blue thing in the presentation of the red ink used above as blue ink, and also were considered as the same presentation was used. The contact angle over the nozzle plate of this blue ink was 39.8 degrees, and surface tension was 30.9 mN/m. And it conveyed to the 3rd dryer 43, ink was dried here, and coloring layer 15b of B (blue) was formed. Desiccation was performed like coloring layer 15r of said R (red). The height (thickness after desiccation) of coloring layer 15b of B (blue) was set to 0.8 micrometers. Then, it conveyed in oven 46, postbake was performed the condition for 220 degrees C and 30 minutes, and the coloring layers 15r, 15g, and 15b were stiffened.
[0079] Then, after performing AP processing (atmospheric-pressure plasma treatment) to the substrate base material 11 with which the coloring layers 15r, 15g, and 15b were formed and forming the front face of bank 13 into parent ink, it introduced into the 4th ink jet equipment 34, and the coating liquid L for protective coats was applied to the whole field in which the coloring layers 15r, 15g, and 15b of the substrate base material 11 are formed. As coating liquid L for protective coats, acrylic resin, an epoxy resin, a coupling agent, diethylene-glycol wood ether (solvent of 162 degrees C of boiling points), and the thermosetting resin constituent that consists of butyl carbitol acetate (solvent of 247 degrees C of boiling points) were used. The contact angle [as opposed to 6 mPa-s and a nozzle plate in the viscosity of this coating liquid L for protective coats] was 50 degrees, and surface tension was 28 mN/m.
[0080] The 4th ink jet equipment 34 was constituted so that the maximum of the width of face which can be applied by carrying out 1 ******** of the ink jet head groups 1 might be set to 152mm. And on the substrate stage 4, the substrate base material 11 was set so that the lengthwise direction of the substrate base material 11 might turn into a travelling direction S, and spreading was started from the corner of the substrate base material 11. At the time of spreading, the edge of the paint film formed with one scan controlled the width of face of a paint film to be located outside the service area of the color filter on the substrate base material 11 by setting up suitably the combination of the nozzle 67 which makes coincidence breathe out coating liquid L among two or more nozzles 67. The spreading width of face of 1 scan eye applied from the end of the lengthwise direction of the substrate base material 11 to the other end as 126mm, subsequently to the longitudinal direction of the substrate base material 11 started a new line, and, specifically, performed 2 scan eye. Line feed width of face was set up so that neither a lap nor a clearance might be made between that of the paint film formed by 1 scan eye, and the paint film formed by 2 scan eye, and spreading width of face of 2 scan eye was set to 126mm. 3 scan eye was applied similarly and the coating liquid L for protective coats was applied on the whole surface of the substrate base material 11.
[0081] Then, it conveyed to the 4th dryer 44 and predrying of the coating liquid L for protective coats applied on the substrate base material 11 was carried out by hot plate desiccation. The heating conditions at the time of desiccation were set as for 5 minutes at 100 degrees C. Furthermore, it introduced into hardening equipment 45, and it heat-treated the condition for [200 degrees-C] 30 minutes, the paint film was stiffened completely, the protective coat 16 was formed, and the color filter 10 was obtained. The surface level difference was measured about the obtained color filter 10. Measurement measured the surface level difference about 20 on one color filter, and calculated the average of 20 places. Consequently, the surface level difference of a protective coat 16 was about 0.29 micrometers. Moreover, the TFT mold liquid crystal equipment of the transparency mold which has the configuration shown in drawing 11 was manufactured using the obtained color filter 10. When the obtained liquid crystal equipment was made to drive, the interference nonuniformity in the edge section of a display screen was not accepted, but the good display was obtained.
[0082] (Example 1 of a comparison) In the above-mentioned example 1, a protective coat 16 was not formed all over the substrate base material 11, but it formed only in the service area of a color filter 10, and also the color filter was manufactured similarly. That is, the black matrix 12, bank 13, and the coloring layers 15r, 15g, and 15b were formed on the substrate book material 11 like the above-

mentioned example 1. Then, after performing AP processing and forming the front face of bank 13 into parent ink, the coating liquid L for protective coats was applied only to the field which turns into a service area of a color filter 10 on the substrate base material 11 by the ink jet method. The coating liquid L for protective coats used the same thing as the above-mentioned example 1. Then, like the above-mentioned example 1, after performing predrying and heat curing of a paint film, the substrate base material 11 was cut and the color filter was obtained.

[0083] About the obtained color filter 10, the surface level difference was measured like the above-mentioned example 1. Consequently, although the surface level difference of a protective coat 16 was about 0.30 micrometers, when were used for the TFT mold liquid crystal equipment of a transparency mold like the above-mentioned example 1, and making liquid crystal equipment drive, the interference fringe by which thickness nonuniformity is considered to be the cause by the periphery section (edge section) of a display screen was observed.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the fragmentary sectional view showing the 1st operation gestalt of the color filter of this invention.
[Drawing 2] It is the outline block diagram showing the example of the production line used suitable for the manufacture approach of the color filter of this invention.
[Drawing 3] It is the outline block diagram showing the example of the ink jet equipment used suitable for the manufacture approach of the color filter of this invention.
[Drawing 4] It is the top view showing an example of the array of the ink jet head in the ink jet equipment of drawing 2 .
[Drawing 5] It is the important section cross-section perspective view of the ink jet head in the ink jet equipment of drawing 2 .
[Drawing 6] It is the sectional view of the ink jet head in the ink jet equipment of drawing 2 .
[Drawing 7] (a) - (e) is the type section Fig. having shown how to manufacture the color filter of the 1st operation gestalt, in order of the process.
[Drawing 8] It is the top view showing other examples of the array of the ink jet head in the ink jet equipment of drawing 2 .
[Drawing 9] It is the sectional view having shown the example of the liquid crystal equipment concerning this invention.
[Drawing 10] It is the sectional view having shown the example of the liquid crystal equipment concerning this invention.
[Drawing 11] It is the decomposition perspective view having shown the example of the liquid crystal equipment concerning this invention.
[Drawing 12] It is the fragmentary sectional view showing the 2nd operation gestalt of the color filter of this invention.
[Drawing 13] It is what showed the example of the electronic equipment concerning this invention, and (a) is the perspective view of a cellular phone and (c) is [(b) is the perspective view of a pocket mold information processor, and] the perspective view of wrist watch mold electronic equipment.
[Drawing 14] It is the type section Fig. showing the example of the conventional color filter.
[Drawing 15] It is an outline sectional view for explaining the surface level difference in the conventional color filter.
[Description of Notations]
10 90 -- Color filter
11 91 -- Substrate base material
11a, 91a, 501 -- Substrate,
15r, 15g, 15b, 95r, 95g, 95b, 502r, 502g, 502b -- 16 A coloring layer, 96,503 -- Protective coat
1 -- Ink jet head group
67 -- Nozzle
72 -- Ink jet head
L -- Coating liquid for protective coats
100,200,300 -- Liquid crystal equipment
101,201,314 -- Opposite substrate
103,203 -- Liquid crystal layer

D -- Surface level difference

[Translation done.]

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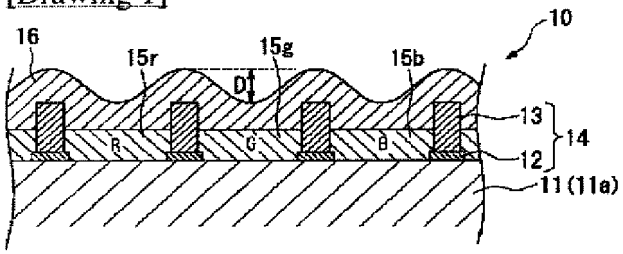
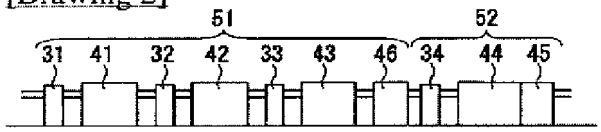
DRAWINGS

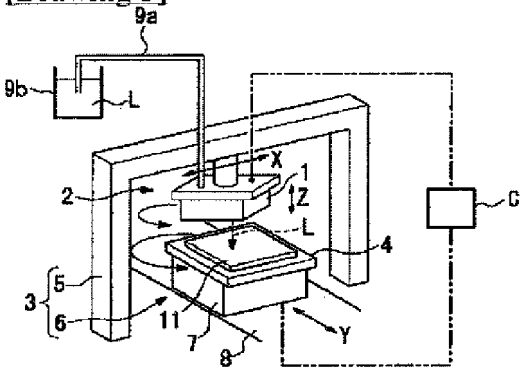
[Drawing 1]



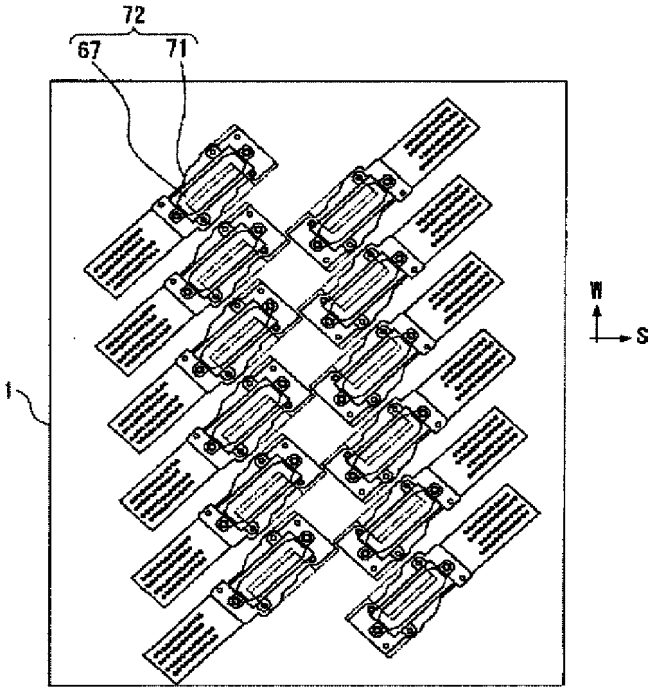
[Drawing 2]



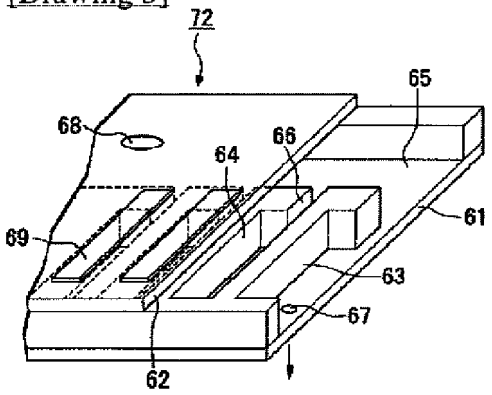
[Drawing 3]



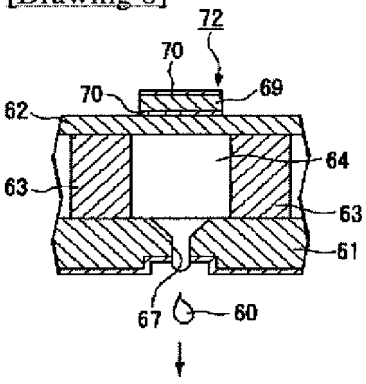
[Drawing 4]



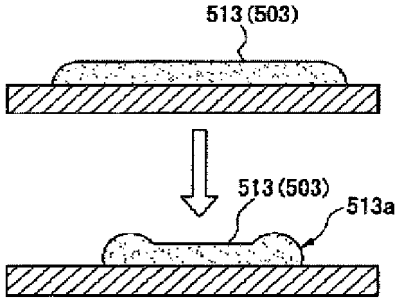
[Drawing 5]



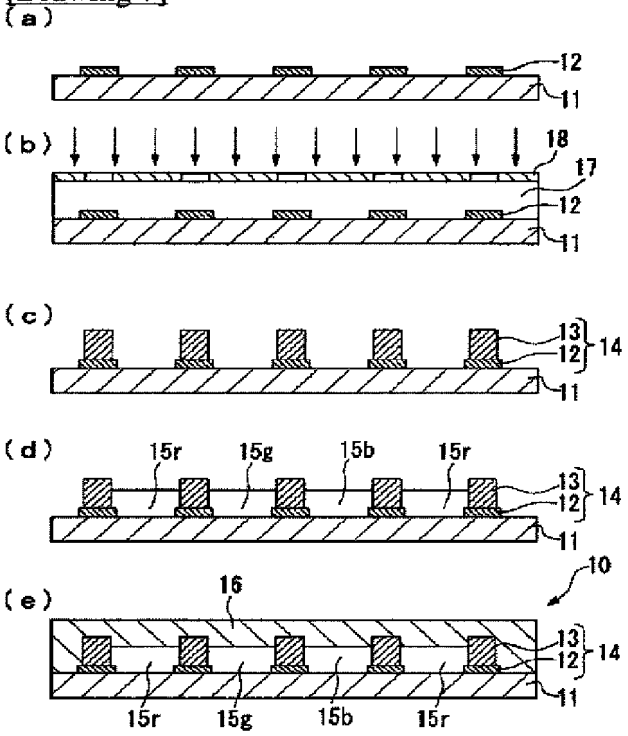
[Drawing 6]



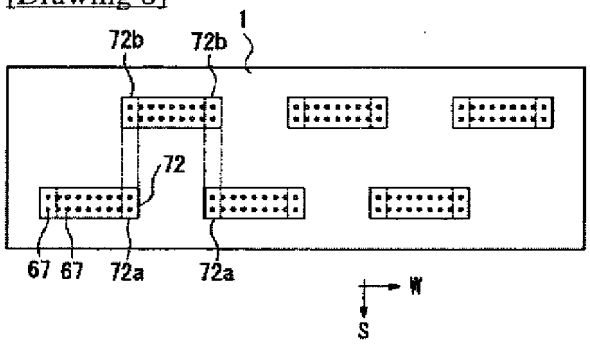
[Drawing 15]



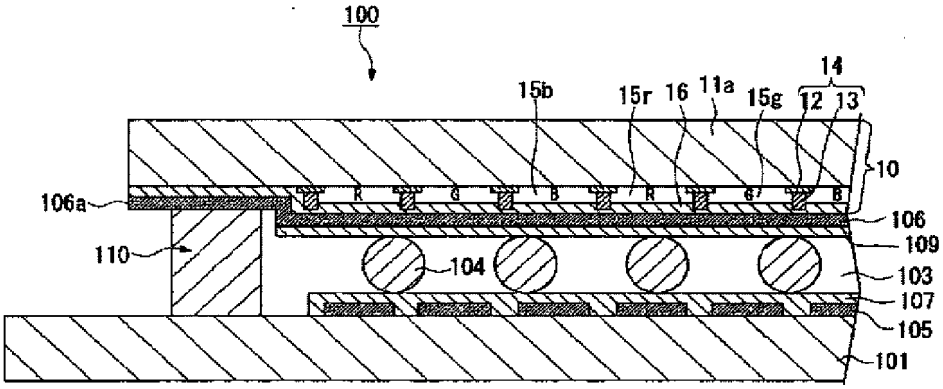
[Drawing 7]



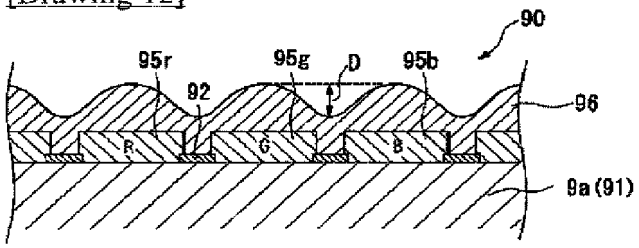
[Drawing 8]



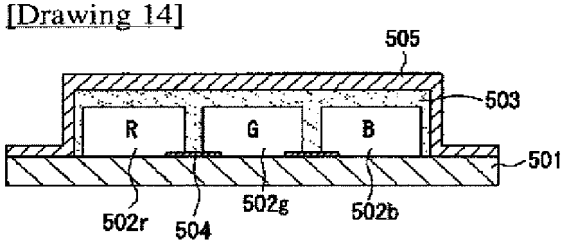
[Drawing 9]



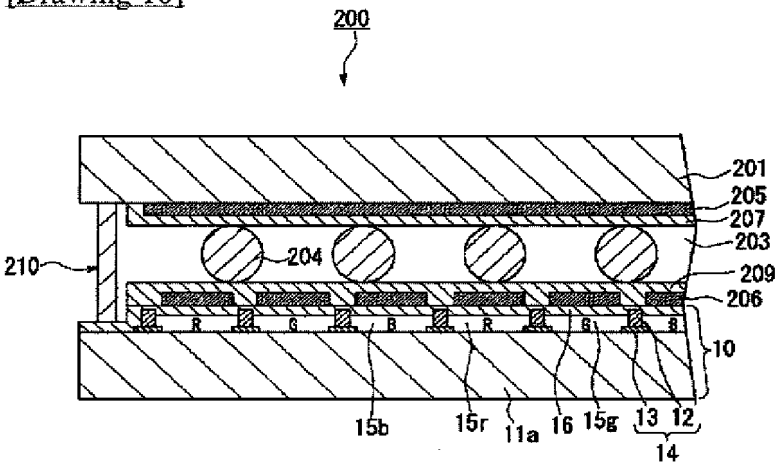
[Drawing 12]



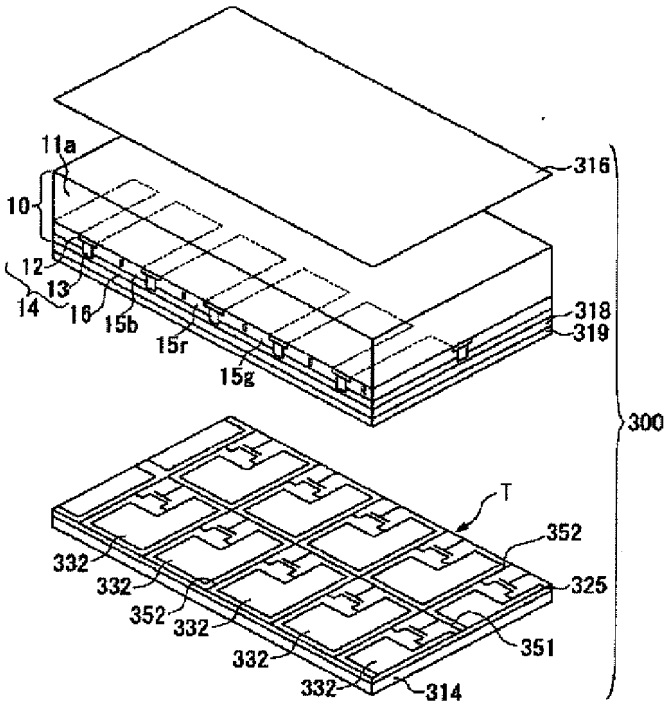
[Drawing 14]



[Drawing 10]

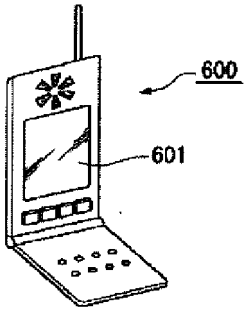


[Drawing 11]

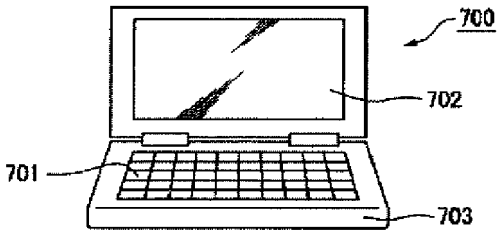


[Drawing 13]

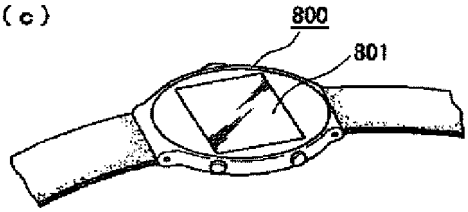
(a)



(b)



(c)



[Translation done.]